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THE EVOLUTIONARY SIGNIFICANCE OF HUMAN CHARACTER.[1]

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THE complicated constitution of the human mind is well impressed on the investigator as he seeks to understand the origin of any one of the many different types of character which come before him. The number of possible combinations of its numerous elements, each of which present developmental phases, is necessarily very great. The *species* of human minds, as one may properly term them, are probably as numerous as the species of animals, as defined by their physical structure. As in the case of anatomical species, however, analysis of the mind reduces its many details to a few leading departments. Although the classification of the elements of the mind is a classification of functions; it is, if correct, a sure index of the classification of structure also; of the grosser and more minute structure of the brain, principally of the gray matter.

The division of mental activities into three primary divisions is generally admitted. These are: the emotions, the intellect and the will. The emotions include the likes and dislikes, or the tastes, and their strongest forms, the emotions and the passions. The intellect includes those powers which rearrange the experiences in an order different from that in which they enter the mind. This new order may have sole reference to questions of liking and disliking, and is then a product of the imagination; or it may be a result of experience of the laws of pure necessity,

[1] The present article is in continuation of the previous one on the Evolutionary Significance of Human Physiognomy, published in the NATURALIST of June, 1883.

without regard to questions of taste; then it is a process of reason. The will, properly so-called, is the spontaneous power of the mind by which the other processes are originated, directed or restrained. The range of the will, and even its existence, are questions of dispute.

Below and behind these mental activities lies *sensibility* or consciousness, in its forms of general and special sensation; that is, touch, and hearing, taste, smell, sight, and the muscular sense, with many others, concomitants of both health and disease. It is well understood that these primitive mental qualities are more or less developed in animals, in which the more purely mental functions are rudimental. The doctrine of evolution teaches that from this class the higher activities of the mind have been developed, during long ages, through the agency of memory. The nature of the present essay only permits a casual reference to the astonishing character of memory, and the remark that its phenomena demonstrate most clearly, of all others, that mind is an attribute of some kind of matter.

If we now consider these natural divisions of the mind as they present themselves in the combinations which we call human character, we shall observe a variety in the mode of their action which pervades all divisions alike. These variations fall under two heads, those of *quantity* and of *quality*.

Thus as to quantity; one human mind may present a greater amount of intellectual than emotional activity; of imaginative than rational intellection; of affectionate than irascible emotion; of gastronomic than musical taste, etc., etc. The quantity here indicated is probably an index of the proportion of brain tissue devoted to the functions mentioned. The intensity or force of the action is a matter of quality.

Of qualities the variety is much larger. They are often parallel to those of inorganic force, and suggest the same kind of modifications of the material bases, as those which effect the latter. Two prominent qualities are *fineness* and *coarseness*. Fineness observes and uses detail in both rational and emotive acts, and is essential to the precision of finish. Coarseness neglects detail, but deals with the gross of things, and is sometimes accompanied by largeness of quantity. When it is not, the result is not good. Fineness is, on the other hand, often associated with smallness. It is a more feminine attribute, while coarseness is more masculine.

Another pair of antithetic qualities are *intensity* of action and the reverse. This probably means that a given bulk of brain tissue produces a greater amount of energy in a given time than an equal bulk of non-intense tissue.

The *speed* or rate of action in time, and its opposite, slowness, are related to the last named qualities, but are not identical with them. Thus growth of the mind always witnesses a diminution in the rate of action, but an increase in intensity.

Tenacity of mental action is a very marked character, and of great importance. It signifies the persistence of mental action, or mental endurance, and may characterize the entire mind, or only a part of it. Its opposite, seen in changeability, desultoriness or fickleness, may also characterize all or a part only of the mind. According as it characterizes the intellectual or emotional departments, are its exhibitions most varied, though they probably have a common histological basis.

Impressibility and *stolidity* express antitheses of character which are seen every day. The term impressibility is used as identical with irritability, and is preferred, because the latter has special physiological and popular meanings, some of which are only among its phases. These qualities are apt to pervade the entire mental organism, although, like others, they may characterize a part only. Impressibility is obviously a condition of tissue, since it varies greatly with physiological conditions in the same person. Its exhibitions in the department of the emotions may be confounded with strong development of the emotions themselves. A moment's thought, however, shows that easy excitation of emotion is a different thing from energy of emotion, and is often found apart from it. Impressibility of intellect shares with tenacity a leading position as an attribute of a first-class mind, and the combination of the two, forms a partnership of superior excellence.

I may mention here a quality whose absence is pathological, and hence does not properly enter the field; this is *tonicity*. In its normal condition every organ should be supplied with sufficient nutriment or energy to ensure the occupation of its entire mechanism. Anything short of this is followed by poor work. Debility of mental action in the emotional department is seen in abnormal irritability, such as peevishness or "spooning;" and in the intelligence, in absence of mind and blundering; and in both, in general frivolity.

Returning to the primary elements of mind, we may examine their divisions with reference to the question of growth. To begin with the perceptions, there are great diversities in the acuteness of the general and special senses, and greater and less susceptibilities to physical pleasure and pain. In the important representative faculty memory, the differences between people are great. As perception as well as thinking involves a certain amount of structural change, it is evident that susceptibility or impressibility of the senses, which is the first stage of memory, signifies ready metamorphosis of tissue. Unimpressibility, which impedes memory, is a consequence of resistance on the part of tissue, to the usual stimuli. Hence the effect of "sights, sounds and sensations" is greatest in childhood, and the memory is most impressible, for at that time the nervous tissue is undergoing constant change, and nutrition being in excess of waste, constantly presents new material to be organized. And I may here refer to the general truth, that consciousness of all kinds is the especial and distinguishing attribute of life as distinguished from death or no life.[1] Whatever other phenomena we may be accustomed to regard as "vital," are only distinguishable from inorganic motion or force, because they primitively took their form under the guidance of consciousness, and are hence, so to speak, its children. With the perfect working of most of the mechanism of the body, consciousness no longer concerns itself, although it may speedily do so in pathological conditions. This prerogative is now restricted to the nervous system, and to certain parts of it; the one which is, histologically speaking, the most generalized of the systems. And it is quite consistent with the "doctrine of the unspecialized," that nervous tissue in its unfinished state in childhood should be more impressible to stimuli than at later periods of life. But this statement requires this modification, that there is a stage of imperfection of mechanism which does not display high sensibility, as for instance in the earliest infancy. With age sensibility gradually diminishes.

Next in order of appearance in growth are the emotions. It is true that some of these are not fully developed until long after the appearance of many or all of the intellectual faculties; but it is also true that their full development precedes that of the intellect, in so far as they are developed at all. The primitive condi-

[1] The Origin of the Will, *Penn Monthly*, 1877, p. 440.

tion of the emotions is that of appetites. The first of these in the necessary physiological order, and hence in time, is the appetite of hunger. Second in order in the history of life, but not in the growth of individuals, is the instinct of reproduction, such as it is in animals who only multiply by fission. Very early in evolution the emotion of fear must have arisen, and it is probably the immediate successor of hunger in the young of most animals. Anger appears as early as the mind can appreciate resistance to its first desires, and no doubt followed as third or fourth in the history of evolution. The rudiments of parental feeling would follow the origin of reproduction at a considerable interval of time. One of the latest of the instincts to appear, would be the love of power; while later still would be the emotions of relativity (Bain) because they are dependent on a degree of mental appreciation of objects. Such are admiration, surprise and wonder. These, as well as all other consequences of inherited intellect, appear earlier in infancy than they did in evolution, as may be readily understood.

Of these instincts and emotions, it is to be supposed that hunger remains much as it has ever been. The reproductive instinct has, on the other hand, undergone the greatest modifications. Sex instinct could not have existed prior to the origin of the male sex, which must be regarded in evolution as a derivative from the female. Hence it is probable that the parental instinct preceded the sexual in time. These two instincts being the only ones which involve interest in individuals other than self, furnish the sources of sympathy in all its benevolent aspects. Hence it has developed in man into the powerful passion of love; into affection and charity in all their degrees and bearings. Fear being, as Bain shows, largely dependent on weakness, has varied in development in all times, but must be most pronounced in animals of high sensibility, other things being equal. Hence its power has, on the whole, increased until it probably reached its extreme in the monkeys or the lowest races of men. Increasing intelligence of the higher order diminishes the number of its occasions, so that it is the privilege of the highest types of men to possess but little of it. The earliest of the emotions of relativity to appear in time, has probably been the love of beauty; how early it may have appeared it is difficult to imagine. Surprise and wonder as distinct from fear, one can only conceive as following an advanced state of intelligence.

Thus in psychology as in physiognomy,[1] the palæontological order of development is somewhat different from the embryological. I might compare the two orders as follows:

PALÆONTOLOGICAL.	EMBRYOLOGICAL.
Hunger.	*Hunger.*
Reproduction.	*Fear.*
Fear.	*Anger.*
Anger.	*Beauty.*
Parental instinct.	*Wonder.*
Sex.	*Power.*
Power.	*Admiration.*
Beauty.	*Pity.*
Wonder.	*Sex.*
	Parental instinct.

The qualities enumerated in the first column follow each other directly in order from the simple to the complex. In the second column this order is disturbed by the earlier appearance of the derivative emotions, beauty, wonder, admiration and pity, or benevolence, and the later appearance of the simple emotion of sex. Thus in psychological as in other evolution, some of the products of development appear earlier and earlier in life in accordance with the law of *acceleration.*

The intelligence has already been considered under the two heads of the imagination and the reason. The action of the imagination, unmixed with the exercise of reason, is chiefly to be seen in the creative fine arts, as distinguished from the imitative, the mechanic, and other arts. The musician, the painter, the sculptor, the poet, the novelist and the playwright, so far as they are not imitators, present the best illustrations of the work of the imagination. It is a faculty which must be very little developed in the animals below man. They occasionally make mistakes in the nature of objects, and suppose them to be other than what they are. Thus the Antilocapra supposes the Indian disguised with a skin and horns, to be one of his own species, and suffers the penalty. But this is a most rudimental act of imagination, if it be not mere curiosity.

The reason, properly so-called, begins in its lowest grades with the simplest rearrangement of the objects of sense and memory, in accordance with some principle of relation. As the principle or standard of relation varies, so does the intellectual process. If the process be discovery, or the enlargement of knowledge, many

[1] NATURALIST, 1883, p. 618.

experiences (or hypotheses) will be successively encountered and tested, and appropriate generalizations reached (inductions). If the process be to accomplish the practical ends of life by use of well-known means, the intellect uses the customary rules of action as standards, be they moral or mechanical, financial or political, and attains its deductions and applications. These two types of intellect are strikingly distinct, and produce the most diverse consequences. The inductive type is the most generalized, and hence capable of the largest growth and adaptability, and the widest range of thought. The deductive is the more specialized, the more "practical," but less capable of growth or general thought. Its most remarkable exhibitions are seen in the skill with which some men conduct the game of chess, and corresponding enterprises in real life. Also the ingenuity of mechanical invention, and the wonderful rapidity of calculation which some minds display. In intellectual as in many other vital phenomena, the facility once developed, the active process is often unaccompanied by consciousness in many or even all of its stages.

Rapid and exact control of the muscles in obeying the directions of the mind is essential to the practice of many arts, especially to that of the musician. This accomplishment is acquired through the medium of the conscious mind, and may be regarded simply as the reflex of impressions made on the senses directed by some simple rule which has been impressed on the memory. The often surprising results involve the exercise of a very simple phase of intellection.

The appearance of the rational faculties in time, may be estimated by their relative development in the existing divisions of animals whose period of origin is known or inferred. The animal mind is capable of simple forms of induction and deduction, and sometimes acquires considerable artistic skill. Bees, ants and spiders display these in varying degrees, and their antiquity is probably coëxtensive with that of the known sedimentary rocks. The supposed Ascidian ancestors of the Vertebrata, and even the lowest vertebrate (Branchiostoma), display far less intelligence than the articulates mentioned, which are really lower in the scale of organic types. From such unpromising sources did the noble vertebrate line descend. It is probable that the inductive act preceded by a little the deductive in time, as it does in logical order. But the elaboration of these powers was doubtless long delayed;

for untold ages they involved nothing more than the discovery and application of general principles of the simplest kind; such as the customary sequence of natural phenomena, and the anticipation of their operations, as, for instance, in the laying up of winter provisions. Occasionally deductive application of an old rule to a new case would arise, as in that of the Mygale spider which was observed by Dr. McCook to substitute cotton for her own silk for the lining of her nest. The development of the rational faculty has been rather in quantity and quality, than in the nature of its constituent parts. I may remark, however, that the embryological order is here again different from the palæontological. Inherited aptitudes, as for music, calculation, etc., precede, in children, any considerable powers of thought, while the order of development of the race has been the reverse.

As regards the appearance of the qualities of mind already mentioned, which depend on character of tissue, it is difficult to present an order which shall be generally true. Our ignorance of the subject is profound; nevertheless observation of animals and men leads to the following conclusions: First, the primitive mind is negative, unimpressible, and little sensitive. In evolution, sensibility has been developed under stimuli, and diminished by disuse and repose. The energy of high-strung sensibility has probably ever won for its possessors success in the struggle for existence, and more or less immunity from the pains which stimulate to action.[1] It is true that the non-aggressive and ever-harassed Herbivora have developed the higher brain structure. The inferiority of brain type of the Carnivora is a well-known fact of present and past time. The early ruminants were smaller than the contemporary flesh-eaters, and therefore subject to the greatest risks. The best developed brains, those of the Quadrumana, have been developed in still more defenseless animals, who in their arboreal life have been confronted by still more complex conditions.

Impressibility or sensitiveness has evidently been the means of acquisition of some of the other qualities mentioned. Thus *intensity* may have resulted from active use accompanied by vigorous nutrition, and the consequent construction of compact force-converting tissue. *Rapidity* without intensity must also result from exercise, with a less vigorous construction of tissue.

[1] The relation of Man to the Tertiary Mammalia, *Penn Monthly*, 1875.

Fineness and *tenacity*, on the other hand, cannot be regarded as being so much produced by use, as by very primitive conditions of tissue. Restraint under pressure might produce fineness. Long continued freedom from sudden changes, under pressure, might account for the origin of tenacious tissue. As to quantity, deficiency or diversion of nutritive energy or material must produce smallness, and the reverse condition, largeness.

These qualities impress themselves on the external as well as the internal organization, and can be more or less successfully discerned by the observer. I reserve the question of physiognomy to a later article, and here consider only the evolutionary bearings of character itself. As in physiognomy, we may arrange the faculties and their qualities under the two heads of ancestral and embryonic, or that of the species and that of the individual. The order of succession is the same in both kinds of development.

SPECIES.	INDIVIDUAL.
Indifference.	*Indifference.*
Emotions.	*Emotions.*
Intellect.	*Intellect.*
a. *Imagination.*	a. *Imagination.*
b. *Reason.*	b. *Reason.*

It is not practicable to go farther than this into the order of evolution of characteristics. There is probably little uniformity of sequence other than that I have already pointed out under the head of the emotions.

As a complex outcome of the emotional and rational faculties, must be now mentioned the moral sense, or the sense of justice. It consists of two elements, the emotion *benevolence*, and the rational power of *discrimination* or judgment. The former furnishes the desire to do what is right to a fellow-being. Without the aid of reason, it is benevolence, not justice, and may often fail of its object. The rational element has acquired from experience a generalization, the law of right. It perceives what is most conducive to the best interest of the object of benevolence in his relation to others or to society, or whether he be a proper object of benevolence at all. By itself, this quality is absolutely useless to mankind. When it guides the action of human sympathy, it displays itself as the most noble of human attributes. Many animals display sympathy and benevolence, but justice has not yet been observed in any of them. Hence it has been said that it

cannot be a derivative faculty, but is "intuitive" in man. The objection to this view is its great variability and occasional entire absence in man, individually and racially. It is the last to appear in individual growth, as it has doubtless been in the order of evolution, of mind.

I now devote a little space to the discussion of the distribution of these qualities in races and sexes.

As regards the relative preponderance in action of the emotive and intellectual faculties, it is an axiom that in the great majority of mankind, apart from the necessities imposed by the simple physical instincts, it is a taste or an affection or an emotion that lies at the basis of their activities. Perhaps the most universal is the affection of sex. Given two types of rational beings who are objects of admiration and of pleasure to each other, each of whom desires to possess the other, and who therefore employs many devices to please and attract the other, and we have an effective agent of general development. Then the parental and especially the maternal affections, arouse and direct many labors. Fear of suffering and death is at the basis of many others. The love of power or of possession, including ambition, is a well-known stimulus. The love of beauty is a strong motive in many persons. The pleasure derived from the exercise of the intelligence is a sufficient motive for a life work in a comparatively small number of persons. These are the artists and the scientists; but it is far from being an unmixed motive in many of them.

Intellectual motives, however, enter into association with the affectional in many instances, as for example in the profession of teaching. But it is as guide and agent in the accomplishment of the main ends of life that the intellect, especially the reason, has its great field, and displays itself in an endless variety of ways.

If we now survey men as we find them, it is a general truth that it is in the male sex that the greatest proportion of rational method is to be found, and in the female the greatest proportion of the affectional and emotional. As we descend the scale of humanity, the energy and amount of the rational element grows less and less, while the affectional elements change their proportions. The benevolent and sex elements diminish in force more rapidly than the other sentiments, but it is probable that all the emotions are less active in savages, excepting those of power and

of fear. In the lowest races there is a general deficiency of the emotional qualities, excepting fear, a condition which resembles one of the stages of childhood of the most perfect humanity. To this must be added revenge, where hatred may be reinforced by several other sentiments, with a feeble perception of equivalent suffering or punishment, which may or may not be just. The pleasure of muscular exercise is greatly developed in people of out-door habits.

The order of the appearance of the intelligence is nearly dependent on the development of the powers of observation. In most savages these are very acute, and vary according to the nature of the environment which impresses them. The character of most civilizations tends to diminish the power of the perceptive, while the higher departments of imagination and reason are enlarged. The imagination reached a high development before reason had attained much strength. With the exception of a few families, the intelligence of mankind has, up to within two or three centuries, expressed itself in works of the imagination. When exact knowledge first began to be cultivated, it was in the department of astronomy, where the least precision was attainable, and where the greatest scope for the imagination is to be found.[1] Next in time metaphysics was the throne of learning, a field in which much may be said with the least possible reference to the facts of observation. With the modern cultivation of the natural and physical sciences, the perceptive faculties will be restored, it is to be hoped, to their true place, and thus many avenues opened up for the higher thought power of a developed race. Thus it is that in the order of human development there is to be a return to the primitive powers of observation, without loss of the later acquired and more noble capacities of the intellect.

The relation of the qualities of impressibility, fineness, intensity, speed and tenacity to our development, in time, may have been as follows: Impressibility of mind is no doubt an embryonic character of "retardation," parallel and probably a consequence of the retardation which is found in the human skull and face.

[1] The governments of antiquity required the knowledge of the Chaldean astronomers as important to the success of their undertakings, and the governments of Europe and America were, for a long period, more liberal in their support of astronomy than any other science. At present, however, geology shares in this aid, and to a less degree botany and zoölogy.

The preponderance of the osseous and nutritive elements over the nervous, is the usual accompaniment of non-impressibility, and *vice versa.* Hence this quality is of late origin in the history of the Vertebrata and of man, and is most developed in the young, and better developed in women than in men.

Tenacity has an opposite significance, being an especial characteristic of maturity in the human mind. Hence it may have been more general in early ages than at present, but could have little value so long as the mind remained small in quantity. Curiously it is a quality which may coëxist with a good deal of impressibility.

Fineness can only be a quality of full development, and is totally independent of the other qualities. It is unknown among savages, and is developed apparently in a few animals. Of intensity it is difficult to say much definitely. The nervous operations of animals often display the highest degree of this quality, and it is not unlikely that its appearances differ as much in savages as in civilized people. Its importance in mental action depends of course on the kind and amount of mental function which exhibits it. The same may be said of speed. The faculties which exist are more or less affected by it. In the well formed reason it is an important characteristic, and a special form of development.

Having gone as far into the origin and developmental relation of mental functions and qualities as the nature of this sketch permits, I refer briefly to the stimulus to their growth; always remembering that the percentage of inherited qualities is much larger in a given character than that of acquired ones. On this head one word expresses a good deal, and that word is *use.* No truth is better known than this one, that mental faculties develop with use more rapidly than those of any other organ of the human body. Brain and nerve are apparently the most plastic of all tissues; the one which retains the properties of the primitive protoplasm, multiplied and intensified a thousand fold. It has always been the seat of creation, throwing off its "formed matter" in useful directions. It is still doing so; and in the human brain ever creating itself, is in addition, the seat of a new creation, which it executes through its instruments, the other organs of the body. Hence the greatest sin against the brain is idleness, or disuse. The brain activity of to-day is an indication of health and happiness beyond what the world has seen hitherto.

The greatest stimulus to exercise of the brain is human society. Hence the greatest developments of mind have always been in the centers of population. Whatever may be the passive virtues of country life, it is the cities that furnish both the stimulus and the field for the triumphs of mind.

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OBSERVATIONS ON THE HABITS OF THE AMERICAN CHAMELEON (ANOLIS PRINCIPALIS).

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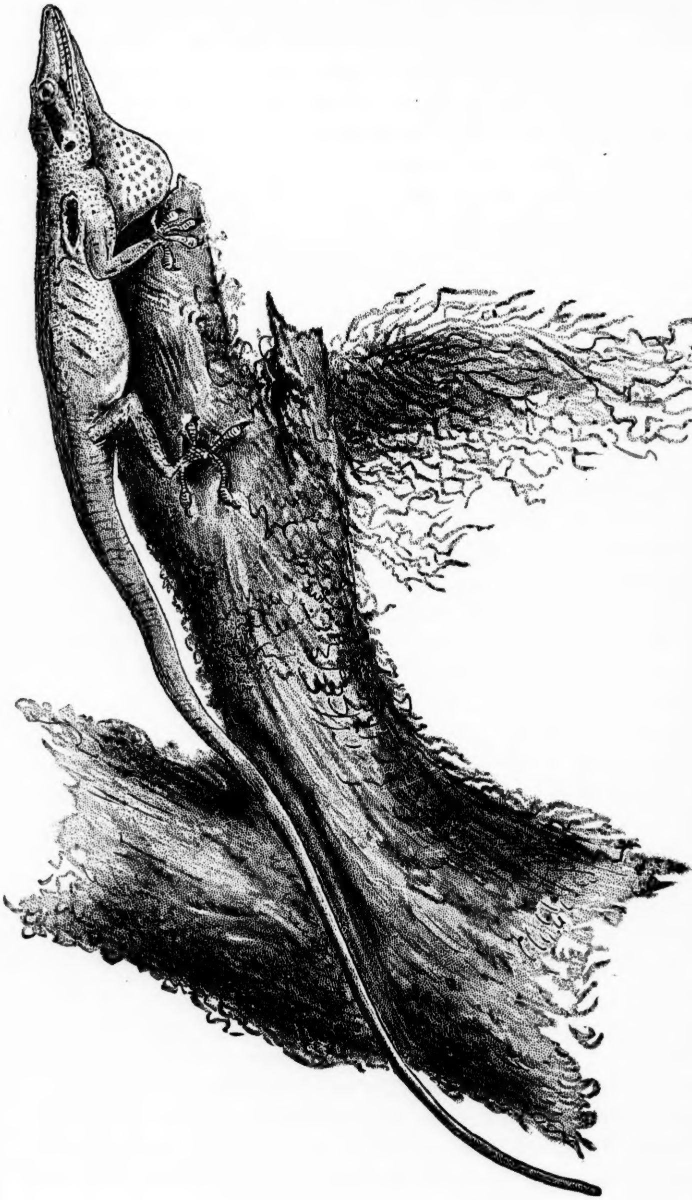
UNDER all circumstances lizards are interesting creatures, meet them where we may; as one evidence of this, how often do we find them chosen, and that, too, for many ages gone by, as objects to adorn pottery, vases and china, or modeled in silver and gold to be worn as jewelry, or cast in the baser metals for other purposes, such as bronze ornaments. There is something very mysterious, at times, in their very look, their dignified mien, their almost provoking silence; this is changed in us to a sense of curious interest that is quickened as the reptile assumes its livelier air, darts along the tree branch that it may be on, or shoots with the rapidity of an arrow up the trunk of some old tree. This singular interest amounts to positive fascination, as we come to know the anolidae, and I assure you our little American chameleon is one of the most engaging of the group, at the same time, being one of the commonest of all the lizards found throughout the lowlands of Louisiana; indeed, I have known instances of two or three children capturing as many as twenty-five or thirty in some old magnolia grove in the course of an hour or two, and we may well imagine the number that would escape from our juvenile collectors. It is certainly the exception though, that any one ever disturbs or injures, either in city or forest, this inoffensive and harmless little creature; entitled as we are, however, to claim this for ourselves, it must be remembered, and it is a fact not commonly known, that in the town and its immediate neighborhod the chameleon has an uncompromising enemy in the domestic cat. This animal, I have been informed upon undoubted authority, will, when the opportunity presents itself, pass anything, meat, birds, and even fish, if there is the slightest chance of securing one of these lizards, of which they seem to



Anolis principalis; life size; from nature, by R. W. Shufeldt, U.S.A.

be so inordinately fond. The cat will stalk one, just as we all have seen them attack some unsuspecting sparrow. Should the lizard be on the trunk of a tree, and low down near the ground, and the cat miss it in her spring, she will frequently, in her disappointment, chase it up the tree, where of course the reptile wins in such an unequal race.

In the forest, Anolis, no doubt, has many another animal foe that makes it its prey. Our smaller hawks often seize and devour them, when they appear, and are exposed in the open.

In addition to this, thec hameleon is subject to other accidents; its long tail is frequently broken off; this may grow out again as it does in Ophisaurus, though I have in my possession a specimen where this extremity healed over instead. Another specimen in my collection, has some time or other, apparently long anterior to capture, lost a foot, in this case a very pretty little stump has resulted, leaving a member of considerable use.

I have, perched up before me, one of these little fellows, that was taken for my special benefit several days ago; the reader is presented with a very careful and accurately measured drawing that I have made of him. They sometimes attain a length to exceed this one, by two or three centimeters, rarely more. His entire form is covered with the most delicate and minute scales, which are found to be larger along the borders of the jaws and top of the head, where they are regularly arranged. The nostrils are seen within the rounded border of the snout above, and the bright, black little eyes peep out through longitudinal slits forming the eyelids, the latter being at the base of rather sunken orbits. The oral gape is capacious, and the aperture leading to the internal ear is found a few millimeters to the rear of its commissure. In some specimens a jet black patch is found between the eye and ear, and another above the forearm on the side, surrounded by a whitish border; one or both of these markings may be absent, the anterior one being by far the most persistent. During deep inspiration eight ribs may be counted on either side of this lizard's body; these rarely show when the specimen is at rest and in good condition. See what peculiar feet he has, particularly the hinder pair, and I have taken unusual pains to represent these correctly, and to the best advantage. The fore feet are arranged quite symmetrically, but the toes on the rear pair can be spread out as shown in the cut, or drawn down, side by

side, to form a very narrow, and we must own, much more sightly foot. Lying in the median plane, beneath the throat and reaching back as far as the sternal space, Anolis possesses a peculiar ornament; this consists in a fold of the common integument, controlled by an exceedingly interesting apparatus that gives it the power of protruding downwards and slightly forwards at will, carrying the fold with it, to fully the extent shown in the figure, or even more. Upon complete retraction this appendage is scarcely discernible. Its sudden appearance has a very striking effect, as the skin of which it is composed is of a bright red color, being decked over with the white scales, which are here larger than usually found elsewhere on the body, that stand apart by the stretching. Out of the large number of specimens that I have examined alive, this curious affair never appeared to be missing, though in some it was very much more prominent than in others, so we are forced not to attach to it any sexual distinction. The males are crested, also, along the dorsum, another feature which becomes more prominent when this reptile is excited. Under nearly all conditions the ventral parts of Anolis, except the continuity of the tail, are white, longitudinally striped with irregular dusky lines that are much more decided at the throat, and almost amount to a mottling on the belly and chest. A certain amount of mottling occurs high up and along the back. This lizard can assume, apparently at will, one of two colors, or an irregularly distributed combination of both of them; these colors are a bright pea-green, the alternative being a very handsome shade of brownish-bronze, very dark in some old specimens, very light in others.

The first time he comes under your observation he may be descending the trunk of some old cypress; you pause and cautiously approach him; he gradually slows down his advance to a deliberate walk, then stops, slowly raises the fore part of his body, turns his head to one side, and surveys you with a peculiarly knowing gaze, and perhaps even coldly winks once or twice, at long intervals. While this performance is going on his entire body becomes a dead brownish-bronze, ever and anon imperceptibly flushing a lighter tint. You make a step nearer, and he suddenly wheels and heads his course up the trunk, squatting very low as he does so; you come still a little nearer, and he advances up the tree in a spiral direction, until he is on the opposite

side of the trunk and out of your sight. At this moment perhaps the thought seizes you to effect his capture, and you spring forward to head him off; but in his cunning he has outgeneraled you, he is nowhere to be seen on the sides of the rugged old trunk; so for a more general inspection, you back away a few steps, when, to your surprise, far above your head you behold him stretched out along the first horizontal limb that extends from the main trunk. Who would believe it though; who would take him for the same nimble little fellow that had just escaped us! He is now almost completely clothed in a complete suit of bright green, his crimson gular pouch protruding and retracting, reminding one of the opening and shutting of some tropical butterfly in the noon-day sun. At other times, when the surrounding circumstances seemed to demand it, he would have donned a coat made up of irregular patches of the two colors, with their various shades, at his command. This power of protective mimicry on the part of Anolis, for as an example of this we must certainly regard it, serves him best when he resorts, which he frequently does, to the bright green stalks of certain fresh-water reeds and plants that are found growing luxuriantly about the bayous and canals of his native haunts. It was in some such locality as this, that, the other day, I observed one of the prettiest examples of this very same protective resemblance, that one would care to witness, almost equal to that famous butterfly that Wallace so admirably figures in his work upon the Malay Archipelago, now so familiar to all of us.

I had just scrambled over one of these so-called canals, that divided, by the aid of an old fence, an extensive marshy tract from a deserted field; this field was overgrown, in addition to various other kinds of undergrowth, with a tall, bright green, ribbon-like grass. As I pushed my way into this, a shower of grasshoppers arose, making off in every direction; by accident, however, I discovered that two species did not resort to this mode of escape. One of these was of a shade of green that nearly matched the grass in question, the other, larger, was about the shade of the grass after it was dead and dried by the sun. They both had about the same form; the head was long and pointed in front, its apparent length increased by the insect bringing its antennæ together and sticking them out straight forward. Behind, the wrinkled wings trailed out to a sharp point, like the pointed ex-

tremities of the grass blades, and the heavy pair of limbs that spring from the metathorax were long and slender, so as to assist it in the deception. These insects, upon being alarmed, instead of taking to flight as the other varieties did, simply, and with marked deliberation, shuffled down *backwards* to the pointed end of one of the leaves upon which it was resting at the time, and quietly hung there, where it demanded a pretty sharp pair of eyes to detect them, particularly if a breeze kept the grass in motion at the time.

Chameleons placed in alcohol for preservation, change in all manner of ways; the larger share of the green usually disappears, the under parts often become so mottled as to mask the white entirely; it commonly brings out in strong relief the longitudinal stripes on the gular space; the mottling on the upper parts, is likewise made far more evident than in the living reptile. The iris of Anolis, during life is of a bright hazel, with a perfectly round pupil. When taken in the hand, they generally throw the jaws far apart and viciously seize any part of that member, that may come within their reach. The bite of the larger specimens is quite a severe little nip, but I have never seen a case where their delicate teeth could inflict a wound of sufficient depth, so as to bring the blood. They will hang on for a long time, longer usually than our patience will hold out, and it generally results in our detaching them by the free hand. No doubt, as trifling as this bite may be, it often saves the life of our chameleon, as the unsuspicious, or children who pick them up out of curiosity's sake, upon being suddenly pinched in that way, are very apt to involuntarily wring the hand until the lizard looses its hold and promptly makes its escape in the grass or elsewhere.

During the morning hours, among the trees, the chameleons are rarely seen, but as the sun approaches the zenith, and the recesses of the forest begin to be thoroughly warmed, these little fellows may be observed descending the trunks of the trees to engage in their favorite hunting expeditions, about the gnarled roots that are exposed above the ground at their bases. Here they capture all manner of insects which constitute their food, and it is during these feeding times that we have the opportunity to behold some of their quaintest movements. I was so fortunate, not long ago, to catch one in the act, the instant after he had made a successful spring upon rather a large butterfly. The body

of the insect was in his mouth, while the wings were violently flapping at the side of the lizard's face. The reptile would clinch his jaws together spasmodically two or three times, shutting his eyes with a very tight squeeze each time he did so. At last his prey was silent, when with a few energetic kicks he tore off the creature's wings, and disposed of his body *sans cérémonie.*

Anolis principalis no doubt renders, by its constant destruction of those insects which infest the trees of our Southern cities, a great service, and that, too, in a very modest and unassuming way. In this respect how much better they are than that miserable and noisy little foreigner, the so-called English sparrow, that we have taken so much pains to introduce and foster; a bird now found in every city of our Union, from Boston to New Orleans, in alarming numbers; I say alarming, because I know, full well, as every ornithologist in the land knows, that the day is sure to come when we shall have seen enough of his dappled brown coat, so constantly and impertinently intruded upon us, at the expense of our own avian favorites, and we shall learn to regard him, perhaps only when it is too late, as one of the agricultural pests of the United States.

The season approaches when Louisiana, recovering from the temporary shock caused by her mock winter, again puts forth the natural jewels of her animal and vegetable kingdoms, again presents us with fresh flowers and fresh fields, after so short a relapse. Birds once more stream northward, mammals throw off their semi-torpidity and resume their usual avocations. In the overflown bayous, rendered almost unendurable by an atmosphere charged with all the aromatic odors of a budding Southern spring, we at this time, too, see the gaudy representatives of the reptilian world gradually make their several appearances. Frogs croak, Hylas peep, and in some sunny nook the deadly moccasin warms his snuff-brown coils, alone, dreaded and shunned. All rejoice that this happy season once more opens, and the feeble grasp of the winter god is withdrawn. Where is Anolis now? we have not far to go, indeed, to find our bi-colored masquerader; see the emerald-clad scamp as he eyes you from the brawny limb of the pecan, under which you stand. But what is he up to! You quietly watch him, and his employment seems to be of such a nature that he soon completely ignores you, and proceeds with it at all risks, and at all costs. The mystery is soon solved, and we

can readily appreciate this agitation, this bowing and strutting, and all manner of quaint motions, as if the very last drop of his quaint lacertilian blood was on fire—for coyishly, and with all due deference, reclines before his lordship, his chosen mate, exerting all her chameleonic powers to hide her blushes by vain endeavors to match the colored pattern of her couch, with all the bronzes and browns at her command. He can withstand her charms no longer, and for the moment, laying aside all dignity, and the object of his affections not unwillingly submitting, in the next instant finds herself in the passionate embraces of her lord, who, to make sure that he has actually won his coveted prize, winds about her lithe form, perhaps in some mystic love-knot, his entire caudal extremity, and blinds her eyes, first on one side and then on the other, by the extension of the flaming ornament at his throat.

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THE VARIABILITY OF PROTOPLASM.

BY CHARLES MORRIS.

ARE the other planets inhabitable, or is life confined to our earth? This is a question which has been widely debated with various conclusions. It is not probable and hardly possible that the surface conditions and temperature of any other planet of the solar system closely resemble those of the earth. Elsewhere in the universe may be very many planets approaching the earth in condition, and on which life may exist. But as regards the planets of our system the question at issue has hitherto been whether their surface temperature might or might not be near that of the earth. If the former they might sustain life. If the latter it was held that they must be lifeless.

But to say that life can only exist under conditions similar to those with which we are familiar is to make a bold assertion. It is presumptuous to take this little earth as the measuring rod of the universe. Life upon the earth arises from the activity of protoplasm, a highly complex organic compound. It is tacitly assumed that life everywhere must arise from the activity of protoplasm, and that protoplasm can only exist under conditions like those to which we are accustomed. This assumption cannot yet be disproved, but it may be questioned. There are some

reasons for doubting that protoplasm, as we know it, is the only possible physical basis of life. We are beginning to recognize that the essential quality in protoplasm is its high atomed chemical composition and its molecular instability, not some occult property which can exist only in this special compound of C.O.H.N. In fact there is satisfactory reason to believe that in terrestrial protoplasm there frequently occur differences in composition, which differences may, for all we know to the contrary, be occasionally considerable. If it varies thus here, it may vary far more elsewhere, and under conditions of temperature and surface relations different from those of the earth, it seems not impossible that a basic organic substance may exist widely different in its chemical composition from that with which we are acquainted.

This question has been considered, from the chemical point of view, by several writers. The first definite declaration which we find on the subject, is that by Professor E. D. Cope, in a lecture before the Franklin Institute, February, 1874,[1] in which he sums up his conclusions as follows: "We are not necessarily bound to the hypothesis that protoplasm is the only substance capable of supporting consciousness, but to the opposite view, that the probabilities are in favor of other and unspecialized, but unknown forms of matter possessing this capacity." The same view was expressed in more detail in his paper entitled, "On Archæsthetism."[2]

Dr. Persifor Frazer has considered at some length the constitution of protoplasm in his paper entitled, "A Speculation on Protoplasm."[3] He concludes that "If the sarcode or protoplasm be susceptible of slight chemical changes, and in fact suffers such changes without losing the power to fulfill its function of repairing waste tissue, then in the progress of the decay of worlds, and the changes of external conditions consequent upon it, Darwin's law of survival must inevitably be felt where an accidental alteration of the substance of the sarcode and the resulting changes impressed upon the structure, enable one animal to live where others perished." He deems it possible that chemical diversities in protoplasm may become so great as to permit the existence of

[1] Consciousness in Evolution, *Penn Monthly*, Aug., 1875.

[2] AMER. NATURALIST, June, 1882.

[3] AMER. NATURALIST, July, 1879.

life under conditions widely different from those of our planet, and that organic beings may exist under greatly diversified circumstances of temperature and physical relations.

A similar view was later expressed by Professor Cope, who says: "It would be a monstrous assumption to suppose that consciousness and life are confined to the planet on which we dwell. Yet it is obvious that if there be beings possessed of these attributes in the planets Mercury and Saturn, they cannot be composed of protoplasm, nor of any identical substance in the two. In the one planet protoplasm would be utterly disorganized and represented by its component gases; in the other it would be a solid, suitable for the manufacture of sharp-edged tools."[1]

In a letter to the writer from Mr. John A. Ryder, in which he describes his observations upon the characteristics of protoplasm, he relates observed facts which clearly indicate chemical differences. Thus some forms of protoplasm were found to instantly coagulate in the presence of water, while other forms refused to coagulate. He found also considerable difference in color, transparency, general appearance and behavior when exposed to the action of chemical agents. He inclines to the conclusion that "the protoplasm of each species is a distinct organization, and its molecular composition may be of an approximately specific type for each form, with an inherent capacity for variation in the presence of the proper stimuli."

As to the peculiar forms assumed by protoplasm, long thought distinctive, it is now known that inorganic compounds, under certain circumstances, may take on precisely similar forms. This was first observed by G. Fournier in 1878, who found that mixtures of certain inorganic salts produced pseudo-organisms, resembling in appearance cryptogamic plants. Similar experiments made by D. Monnier and C. Vogt produced colloid masses exactly resembling organic cells and tubes. "The artificial pseudo-organic elements are enveloped in true membranes, possessing a high degree of dialyzing power, and giving passage only to liquids. They have heterogeneous contents, and produce in their interior granulations arranged in a regular order. They are, therefore, both in form and constitution, absolutely similar to the figured elements of which organisms are constituted."[2] These

[1] On Archæsthetism, AMER. NATURALIST, June, 1882.

[2] *Comptes Rendus*, XCIV (1882), pp. 45-6.

experiments have been recently repeated by Dr. H. Valin, with results still more marked and surprising.

To the conclusions as to the probable diversity of constitution in protoplasm, arrived at by the above-mentioned authors, may be added another, taken from a somewhat different point of view. There are physical as well as chemical reasons why certain elements, and they only, are the main constituents of protoplasm. This may partly arise from their abundance and general diffusion, yet other elements which take no part in the formation of protoplasm exist abundantly in all parts of the earth. But we may note the additional fact that carbon, hydrogen, oxygen and nitrogen are the only abundant elements which exist under conditions rendering active chemism possible. They all exist as gaseous constituents of our atmosphere, which contains no other element except in minute or local quantities. Two of them, oxygen and hydrogen, combine to form the only generally diffused liquid constituent of the earth. All other abundant elements exist as solids, and usually in the state of oxide.

Such is the general status of the chemical elements. All that are widely diffused, with the exception of atmospheric oxygen and nitrogen, exist as oxides. In consequence their chemical activity has nearly disappeared. At one period in the earth's history inorganic chemical action was probably very energetic. Now it has almost ceased to exist, through a general oxidation and solidification. Yet chemical activity has by no means ceased. Organic chemism has replaced inorganic.

Modern physiological study has reduced to a simple formula the essential principles of organic chemistry. Certain of the oxides are deoxidized. This is the basic principle of vegetable chemistry. The molecules thus produced are reoxidized. This is the characteristic feature of animal chemistry. A cycle of change is passed through, beginning with simple oxides and ending with the same simple oxides, while protoplasm forms the intermediate phase of the cycle. Vegetable chemistry consists of a successive series of deoxidations, by which carbon and hydrogen are released more and more from the grasp of oxygen. The molecular result of these successive changes, compounded in some way with nitrogen, constitutes the basic molecule of protoplasm. The exact method by which this is produced is not known. But it is known that in its production certain stable

chemical compounds are decomposed, and that a complex chemical compound results, rendered highly unstable through the withdrawal of oxygen. The chemical stagnation to which oxidation has reduced the elementary constituents of the earth is partly overcome by this process of deoxidation, and active oxidation becomes again possible.

This active oxidation displays itself in the animal body. The elements concerned fall back towards the state of chemical stability from which they were removed, and the energy emitted during this descent is that which constitutes animal life. But if deoxidation is the chief chemical principle involved in the formation of protoplasm, why is it confined to the elements mentioned? A probable answer seems to be that these elements alone exist upon the earth under conditions which render such deoxidation possible. The other abundant oxides are solids, and therefore removed from any active influence of the agencies which aid the deoxidation of carbon. Some of these elements exist, either in their elementary or in a compound form, dissolved in water, and perhaps in consequence are found in protoplasm. Under proper conditions they might become active instead of passive agents in protoplasm. Some of them which are generally diffused, such as sulphur and phosphorus, seem to be essential constituents of protoplasm.

This review leads us to a significant conclusion. Protoplasm is a result of the successive deoxidation of the only elements whose physical condition renders them susceptible to this change. There is nothing to prove that such a process is necessarily confined to these elements, or that, if a state of affairs should arise in which these oxides existed as solids, and some other oxides took their place as liquids and gases, an organic molecule answering to protoplasm could not be produced by a like deoxidation of these latter elements. To affirm that carbon is the only element which can be deoxidized by the aid of sunlight, or by any form of free energy, is to affirm something of which we can have no knowledge, and it is possible, and even probable, that in other spheres whose atmospheric constituents may consist of simple chemical compounds analogous to, but not identical with, those of our atmosphere, a like process of decompounding and recompounding into complex and unstable molecules may be active, and organic forms exist. To this effect of course the presence of

free energy is necessary, whether it be derived from a sun or from local sources of heat outflow.

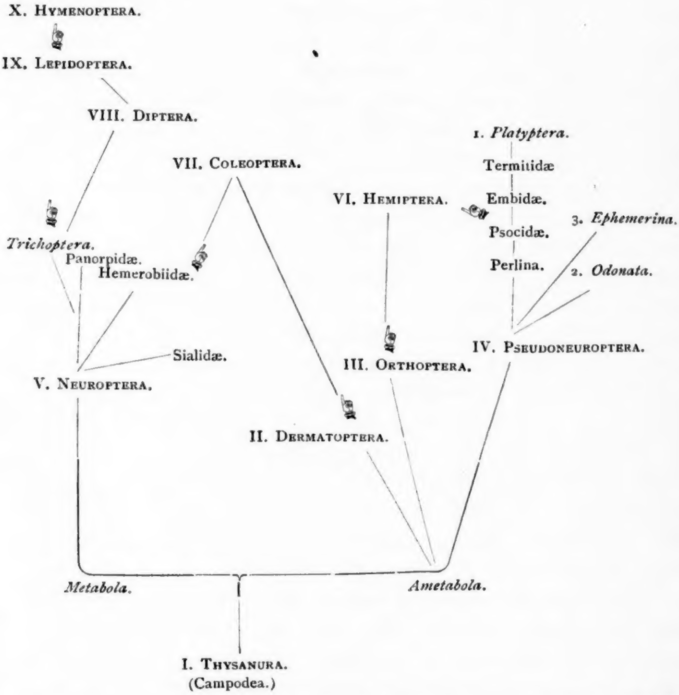
It is, therefore, among the possibilities of chemical action that spheres whose temperature is much higher or much lower than that of the earth may be abodes of life. In an early period of the earth's history, when the elements which are now solid oxides were liquids or gases, some of them may have played the part which carbon now plays, and unstable molecules may have been produced resembling those of organic life. Perhaps some of the complex mineral constituents of the earth's surface are results of such an incipient organic evolution, as the mineral substances known as fossils are results of a more advanced evolution.

This idea leads us to a conception of a long series of efforts towards the evolution of organic life, as the earth gradually cooled, and one after another of its atmospheric constituents became reduced to solidity. Every such substance may, under the influence of heat emissions, have been aggregated with others into unstable compounds, which is the essential principle of organic development. The degree of chemical complexity and instability which could be thus produced would depend largely on the rate of rapidity of cooling. The advantage which carbon has had arises from its coming into play after the cooling of the earth had virtually ceased. Hence its period of activity has been much longer than that of the elements which may have preceded it in this organic process, and the results are immensely superior. But if our argument is of any value we seem to perceive tentative efforts towards organic evolution during the whole period of cooling of the earth's surface, while success in this direction was attained only after a stable condition of surface temperature was reached. In other spheres a long continued stability of temperature may have been reached under other chemical relations, and living beings composed of other constituents than those of earthly organisms have appeared.

ON THE GENEALOGY OF THE INSECTS.[1]

BY A. S. PACKARD, JR.

THE following table will approximately represent our views as to the systematic relations and genealogy of the ten orders of six-footed insects, and is also in general accord with their metamorphoses :



I. *Thysanura.*—This order comprises some lost type nearly resembling Lepisma, Campodea and Japyx, and more especially Scolopendrella, the probable stem-form of the Hexapoda. In other words, from a hypothetical form resembling Campodea or Scolopendrella, it is not difficult to suppose that all or at least the majority of Hexapoda took their origin. It is possible that by a few intermediate steps now lost, Forficula may have descended from the Thysanuran Japyx; this is suggested by the form of the

[1] From advance sheets of the third report of the U. S. Entomological Commission.

body, the head with its V-shaped suture, and the abdomen with its forceps, so like that of Japyx. The genus Lepisma is a rather more specialized form than Campodea, and Machilis is still more so, as proved by its mouth-parts and the presence of compound eyes. Scolopendrella, with its abdominal true legs, comes nearer to our hypothetical form than even Campodea. The group of Poduridæ (Collembola) is most probably a series of degradational forms, originally sprung from a higher, more generalized, Campodea-like ancestor.

II. *Dermatoptera.*—This order, represented by but one family, differs, as already stated, from the Orthoptera, with which it is usually classified, much more than the Termitidæ. It stands alone, and, as observed, its larvæ closely resemble the Thysanuran Japyx.

III. *Orthoptera.*—After the elimination of the Forficulidæ from the Orthoptera, we have a natural and easily circumscribed group. Beginning with decidedly the most generalized and at the same time lowest family, the Blattariæ, followed by the Mantidæ, which have a number of characters which recall the Blattariæ, we pass up through the Phasmidæ to the typical family, the Acrydii; then succeed the Locustariæ, and finally the Gryllidæ, which on the whole are farthest removed from the stem-forms of the order, the cockroaches. The close resemblance of a larval cockroach to Lepisma indicates the direct descent of the Orthoptera from the Cinurous Thysanura.

IV. *Pseudoneuroptera.*—This is the most heterogeneous order or assemblage of Phylopterous insects. While it is comparatively easy to circumscribe the Neuroptera (taken in Erichson's sense) and the Orthoptera, as here restricted, the group Pseudoneuroptera is remarkably heterogeneous and elastic. We have failed to satisfactorily diagnose the order as a whole. The Termitidæ connect the Orthoptera and Pseudoneuroptera so closely that, excepting in the wings and other peripheral characters, they seem but a family removed from the Blattariæ. For example, the Termitidæ resemble the Blattariæ in the form of the epicranium, in the clypeus, which is but partially differentiated at the base from the epicranium, in the form of the labrum, and the small eyes as well as the mouth-parts.

In the thorax the Termitidæ approach the Blattariæ in the undifferentiated scuta of the meso and metathorax; while the pleu-

rites are also very oblique and the femora are flattened and ovate in form, as in Blatta. In the abdomen, as regards the form of the tergites, as well as the urosternites and pleurites, besides the form of the end of the abdomen and of the cercopoda, the Termitidæ closely approach the Blattariæ. The degree of metamorphosis is also the same.

On the other hand, the close relationship of the Termitidæ to the Embidæ, as well as to the Psocidæ and also the Perlidæ, and the close resemblance of the Perlid larvæ to those of Odonata and Ephemerina, forbid our removing the Platyptera from the Pseudoneuroptera.

We conclude, then, that the Ephemerina, Odonata, Platyptera, as well as Orthoptera and Dermatoptera have had a common origin from some Thysanuran stock. It is possible that these five groups are nearly equivalent and should take the rank of orders, but the classification we have given in the tabular view on p. 932 may better express their relations.

The Odonata and Ephemerina are, as regards the wings and metamorphosis, a good deal alike. The Ephemerina, while having a highly concentrated thorax, are, as regards the mouth-parts and hind wings, degradational forms, the result of probable degeneration from a primitive, lost form. From what group the Ephemerina may have originated it seems to us impossible to conjecture.

V. *Hemiptera.*—The only clew to the origin of this well circumscribed order is the fact that in the Physapoda (Thrips) and the Mallophaga the mandibles are free and adapted for biting. This would indicate that the entire group was derived from ancestors allied possibly to the Phyloptera. The Mallophaga are by different authors referred to the Orthoptera and Neuroptera, but the development of the bird-lice as worked out by Melnikow fully proves that in the form of the egg, the mode of development and general form of the embryo, the Parasita and Mallophaga travel along the same developmental path until just before hatching, when in Mallophaga the jaws remain free, while in the Parasita they become further modified and form a sucking beak.

There is a possibility that the Hemiptera may have descended from insects remotely allied to the Pseudoneuroptera; perhaps forms resembling the Psocidæ; at least this family, the wingless forms of which superficially resemble the Mallophaga, gives

hints which may throw light on the origin of the Hemiptera. They are evidently the offshoot of a stock which had an incomplete metamorphosis, or they may have descended directly from a modified Campodea-like ancestral form.

VI. *Neuroptera.*—The members of this order are, excepting perhaps the Hemiptera, the most modern and least composite or synthetic forms that we have yet met with in our ascent up the insect series from the Thysanura. Moreover, in them for the first time do we meet with worm-like, cylindrical-bodied larvæ, or what we have called eruciform larvæ.[1] These larvæ are secondary forms, derived, as Fritz Müller has in a general way suggested, from those larvæ which have an incomplete metamorphosis. By what line of descent, however, the lowest group of Neuroptera, viz., the Sialidæ, arose, it would be difficult to say. The earliest winged insects were probably terrestrial; the aquatic larval forms of the Sialidæ are evidently derivations from Campodea-like terrestrial larvæ. But how the perfect metamorphosis with the quiescent pupa of the Neuroptera was brought about, is indeed a problem. It is evident, however, that the eruciform larva is a derivation from a Thysanuran[2] type, as first stated by Fritz Müller.

It seems to us that a consideration of the diverse larval forms which occur in the present order, throws some light on the origin of a complete metamorphosis in insects in general. In the Sialidæ, as the larva of Corydalis, or Semblis, we have a Campodea-form provided with gills, and with the mouth-parts adapted for seizing and biting its prey. The terrestrial larvæ of the Hemerobiidæ are evidently modifications of the Sialid larval form; the differences of structure in them, such as the long slender mandibles and maxillæ and the short abdomen, being the result of their carnivorous habits, and their being obliged to climb up the stems of plants or to walk over the leaves after smaller insects. Under such circumstances the body would become shorter and more concentrated, and the legs well developed. In the Trichoptera,

[1] See "Our Common Insects," p. 175, 1873. Also the AMERICAN NATURALIST, Vol. v, Sept., 1871.

[2] We have, in the writings just quoted, called the second class of larvæ Leptiform, but the term Thysanuriform, or Brauer's expression Campodea-form, is preferable. The Campodea or primitive Hexapodous form is evidently a derivative form, which points back to a common six-footed ancestor of all Tracheata, to which the term *Leptiform* may be applied.

whose larvæ live in cylindrical cases, the body is seen to be essentially Campodea-like; the head is fundamentally like that of Corydalis; the differences are adaptive.

But when we regard the larva of the Panorpidæ, we are dealing with a new type; it is caterpillar-like, eruciform; its body is slender and cylindrical, the head small and feet short and small. Notice also its habits. The larva of *Panorpa communis* of Europe, as described by Brauer,[1] is remarkably caterpillar-like or eruciform. The head is small, well rounded, and the antennæ and mouth-parts are small and rudimentary, compared with those of other Neuroptera, not excepting the Trichoptera. Moreover, they are constructed on nearly the same type as those of caterpillars; for example, the mandibles are short, toothed, of the same form as in Lepidopterous larvæ; the maxillæ are short, and whether more than two-lobed Brauer does not state, though his figure indicates apparently a rudimentary third lobe; the palpi are four-jointed, while the labium is small with small three-jointed palpi.

The form of the body is thick and stout, like that of a Bombycid (Arctian) larva. The short, four-jointed thoracic feet are in length and thickness like those of caterpillars. But the most striking resemblance to caterpillars and saw-fly larvæ is seen in the eight pairs of abdominal feet, which Brauer describes as conical or pin-shaped (kegelförmig), while on the last (ninth or tenth?) segment are four finger-shaped, equal processes. Not only the form of the body but also the arrangement and shape of the button-like setiferous warts on the body are strikingly like those of some Arctian caterpillars. The pupa has free limbs and wings as in other Neuroptera. The larva of Panorpa bores an inch deep into moss-covered, not wet soil.

The larvæ of Bittacus (*B. italicus* and *hagenii*), as also described and figured by Brauer,[2] have a rounded head with small mouth-parts; the mandibles are, however, rather long, compared with those of Panorpa; while the maxillæ have apparently two inner short lobes, and a four-jointed, short maxillary palpus; the labium is rudimentary, with a pair of short, minute, two-jointed palpi. The body is not so thick as in Panorpa; it is cylindrical and adorned with long, scattered, dorsal spines, which bear one or two

[1] Sitzungsberichte math.-naturw. Classe k. Akad. Wiss., Wien, 1851. Tafel I.
[2] Verhandlungen k. k. zool.-bot. Gessellschaft in Wien, 1871.

branches near the base, while there is a lateral row of slender filaments and a row of ventral verticillate hairs. It thus bears a resemblance to the larvæ of some butterflies, as *Vanessa antiopa*, and especially the young Polyommatus (*Heodes hypopleas*) or the Bombycid larvæ of *Anisota stigma* or Platysamia, as well as Selandria larvæ. Brauer's figures show a pair of abdominal, two-jointed feet to each of the nine abdominal segments, while just as in Lepidopterous larvæ and in that of Panorpa there is a pair of prothoracic spiracles, none on the mesothoracic or metathoracic segments, and there are nine pairs of abdominal spiracles, according to Brauer's figure, or one more pair than in Lepidopterous larvæ.

The fact that there are in the larval Panorpidæ collectively a pair of feet to each abdominal segment (the terminal segment in Panorpa bearing what are evidently homologues of the anal prop-legs of caterpillars) is of much significance when we bear in mind that while no caterpillars are known to have more than five pairs of abdominal or prop-legs, some of the segments bearing none, yet the embryos, as shown by Kowalevsky, have temporary embryonic indications of legs, a pair to each segment (uromere); it is a significant fact that the eruciform larvæ of the Panorpidæ actually have two-jointed legs to each abdominal segment, the penultimate segment in Bittacus bearing such legs, and the terminal segment bearing leg-like processes in Panorpa. The origin of the Lepidoptera from the same stem-form as the Panorpidæ thus seems a reasonable hypothesis.

In the metamorphosis of Mantispa, as Brauer has shown, there is a hypermetamorphosis, *i. e.*, two larval stages. The first stage is Campodea-form but the second is suberuciform. The transformations of Mantispa appear to give us the key to the mode in which a metamorphosis was brought about. The larva, born a Campodea-like form, active, with large, long, four-jointed feet, living a sedentary life in the egg-sac of a spider, before the first molt loses the use of its feet, while the antennæ are partly aborted. The fully grown larva is round-bodied, with small, caterpillar-like feet and a small round head. Its external appendages retrograding and retarded, acceleration of growth goes on within, and thus the pupal form is perfected while the larva is full-fed and quiescent; hence as a result the pupal stage became a quiescent one, and by inheritance it gradually became a perma-

nent habit characteristic of Neuroptera, all of which have a complete metamorphosis. Hence this complete metamorphosis has been inherited by all the orders of metabolic insects which probably originated from Neuroptera-like forms, and the imago represents a highly accelerated stage.

When we consider the imagos or adult Neuroptera, the small collar-like prothorax, the spherical, concentrated thorax as a whole, and the cylindrical abdomen, are features which give them a comparatively specialized and modern aspect. Without doubt

Fig. 1.

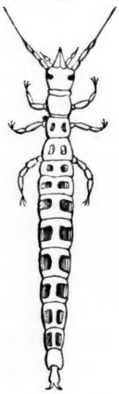


Fig. 2.

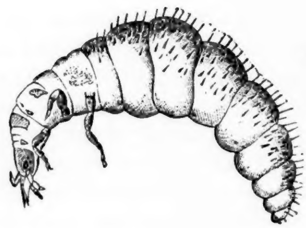


Fig. 3.

FIG. 1.—1st or Campodea-stage of Mantispa, highly magnified. FIG. 2.—Later condition, before first moult; magnified. FIG. 3.—Adult Mantispa, with side view of the same, the wings removed; nat. size.

the Neuropterous labium is a secondary product compared with that of the Orthoptera or the Platyptera, where it is deeply cleft. It will be remembered that in the embryo of all insects the labium or second maxillæ originates like the first pair.

Origin of the Coleoptera.—Although the beetles are a remarkbly homogeneous and well circumscribed order, there are certain larval forms and life-histories which point out with a tolerable degree of certainty the line of development of this extensive order from the Campodea type. There are two series of facts which seem to us to throw light on the subject.

First, the form of the free, active larvæ of the carnivorous groups of beetles. The larvæ of the Carabidæ, Dytiscidæ and Staphylinidæ appear to us to be on the whole more nearly allied to what was probably the primitive form of Coleopterous larva

than those of any other families. This ancestral Coleopterous larva was probably directly related to the Campodea-form ancestor of the Hexapoda. The general form of the body, the homonomous segments, the free, biting, toothed mandibles, the well-developed one or two-lobed maxillæ with their three-jointed palpi, and the well developed second maxillæ (labium), also the four-jointed antennæ, and the presence of ocelli, while showing that the existing carnivorous larvæ are the most specialized and highly developed, also show that they have undergone the least modification from the primitive type of Coleopterous larva. In the scavenger larval forms, as the Silphidæ, Dermestidæ and allied families, the mouth-parts begin to be modified and less developed, and the form of the body undergoes a change, becoming thicker and with less developed feet.

In the Elateridæ and Scarabæidæ, which in general are phytophagous, we see a still more decided change; the body becoming cylindrical and the mouth-parts more aberrant.

In the wood-boring Buprestidæ and Cerambycidæ, and in the leaf-eating Chrysomelid larvæ, we witness a decided departure from the carnivorous type; the mouth-parts show a tendency to become more or less aborted, the legs are frequently wanting and the body more or less maggot-like. Finally, the tendency to a gradual degradation and atrophy of the head, mouth-parts and legs culminates in the grubs of the weevils (Curculionidæ and Scolytidæ), placing them at the foot of the Coleopterous series), and shows that they have undergone the greatest modification of form, and have become adapted to conditions the most unlike those which constituted the environment of the primitive Coleopterous larva.

The relative form of the maxillæ appears to be a good index as to the general development of the body in the different groups of Coleoptera, especially those standing above the wood-boring families. The facts may, for convenience, be arranged in the following form:

Cicindelidæ.—Maxilla with a maxillary lobe or *mala* proper ending in a two-jointed appendage which is longer than the three-jointed palpus. (Antennæ four-jointed; three ocelli.)

Carabidæ.—Maxilla with the mala two-jointed; maxillary palpus four-jointed. (Antennæ four-jointed, bifurcate; ocelli often present.)

Dytiscidæ (and Hydradephaga in general).—Maxilla with the mala absent; the palpi four-jointed.

The maxilla in the aquatic forms of the Carabid type is only a modification of the Geodephagous maxilla; the terminal palpal joint being acute and raptorial.

Staphylinidæ.—Maxilla with a one-jointed inner lobe (Xantholinus), or the mala broad and setose as in the succeeding families (Platystethus and especially Bledius); maxillary palpi three and four-jointed.

The Staphylinid type of maxilla is simply a modification of the Carabid, with a tendency to degeneration in the lower genera (Bledius, etc.). Many larvæ in this family are carnivorous.

Elateridæ.—Maxilla with a two-jointed lobe or mala; the maxillary palpus four-jointed. Antennæ four-jointed, bifurcate as in Carabid larvæ; mandibles toothed. The larvæ of Elater and Athous are free. While generally supposed to be vegetable eaters (as Agriotes), those larvæ which live under the bark of trees in mines made by longicorns and other borers, have been shown by Ratzeburg, Dufour and Perris to be in part carnivorous, living on Dipterous and longicorn larvæ, as well as on the excrementitious vegetable matter filling the burrows. Perris (Insectes du Pin Maritime, p. 190) has pointed out the close resemblance of the mouth-parts of this family to those of the larval Carabidæ.

In the Scarabæidæ, Buprestidæ and the lower families of Coleoptera, the maxillæ are of a rather simpler type than in the foregoing families; the maxillary lobe, or mala, being simple and more or less fringed with stiff hairs. In the Scarabæidæ (Osmoderma), and in Pyrochroa, which is carnivorous, the mouth-parts are as complicated as in any; but in the Buprestidæ and Chrysomelidæ they are less developed, while they are most rudimentary in form and size in the wood-boring weevils and Scolytids; the antennæ and second maxillæ and legs also share in the degradation of structure consequent on the burrowing lignivorous habits of the larvæ.

But it is in the so called hypermetamorphosis of the Meloidæ, that of the blister beetle (Epicauta) as well as Hornia having been fully described and illustrated by Professor Riley in the first report of the United States Entomological Commission (pp.

297–302, Pl. IV), that we have a clew to the probable origin of the different types of Coleopterous larvæ. The metamorphosis of the oil beetle (Meloë), originally discovered by Siebold and Newport and also Fabre, is described in different entomological manuals.[1] In brief, the larvæ of Meloë when hatched are very minute, active, six-legged, slender-bodied creatures, parasitic on wild bees; as the legs end in three claws the insects in this stage are called "triungulins." These larvæ attached to the bees are thus carried into the nests of the latter, where they feed on the bee-larvæ and bee-bread. On becoming fully fed, instead of transforming directly into the pupa state, they assume a second larval form, entirely unlike the first, the body being cylindrical

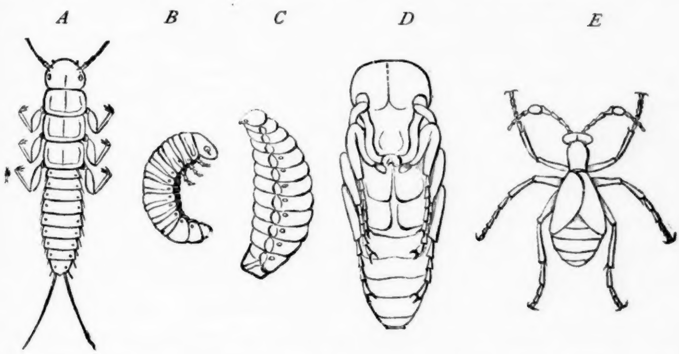


FIG. 4.—Hypermetamorphosis of Meloë. *A*, triungulin; *B*, 2d larva; *C*, 3d larva; *D*, pupa; *E*, beetle.

and motionless, with long legs; they then attain a third larval (coarctate) stage, the head small and the body thick, cylindrical and footless; after this they assume a true pupa stage, and finally become beetles.

Professor Riley has traced the hypermetamorphosis of the blister beetle (Epicauta), which passes through three larval stages before transforming to a pupa. He divides the life-history of this beetle into the following stages: (1) Triungulin; (2) second larva (Caraboid); third and fourth Scarabæoid stage; fifth or coarctate larva; sixth or Scolytoid larva; (7) true pupa; (8) beetle. (The reader should examine the figures in Pl. IV of the first report of the U. S. Entomological Commission, otherwise he

[1] See the writer's "Guide to the Study of Insects," pp. 477–479, Figs. 447–451.

cannot understand the following remarks. See also this journal XVII, p. 790.)

It appears, then, that the first larva, or triungulin, in form resembles the Campodea-like, primitive larval form of Coleoptera; the Epicauta triungulin closely resembles a Carabid larva, the head, antennæ and mouth-parts, as well as the legs and form of the body in general, being on the primitive, Carabid type (somewhat like Casnonia (?), Galerita and Harpalus); the second larva, or Caraboid stage, though quite different as regards the mouth-parts, and with a smaller head, thicker body and much shorter legs, still adheres to the higher Carabid form (Carabus and allies). During the Scarabæoid stage the larva rests nearly motionless in the egg of the locust, and is like the curved clumsy larvæ of the cockchafer or June beetle and other Lamellicorn larvæ, which also have the similar habits of lying still in their burrows and feeding on the roots of grass, or, as in the case of Osmoderma, lying nearly motionless in their cells in rotten wood. This sort of life going on, the larval blister beetle after six or seven days assumes the fourth larval stage, and now, from apparent continued disuse, the mouth-parts and legs become more aborted than before, and the insect in this stage may be compared to some Longicorn larvæ, with a general resemblance in the curved, cylindrical body to the Ptinid and Chrysomelid, and it even approximates in general shape Curculionid larvæ. In the pseudo-pupa or coarctate larva this process of disuse and obsolescence of parts culminates in the immobile stage preceding the pupal condition. We thus see that in the life-history of a single species of beetle, change in the habits or environment, as well as in the food, is the cause of a change in the form of the body; and this series of changes in the Meloidæ typifies the successive steps in the degradation of form which characterizes the series of Coleopterous larvæ from the Carabidæ down to the Curculionidæ and Scolytidæ. At first all larvæ were carnivorous and active in their habits, with large mandibles and well developed accessory jaws and legs; certain forms then becoming scavengers, their appendages became, from disuse, less developed; then others, becoming phytophagous, became in some cases still less developed, the jaws shorter and toothless, with corresponding modifications in the other mouth-parts, the antennæ and the legs, while the body became thick, fat and cyl-

indrical; until in the wood-boring and seed or nut-inhabiting weevils the antennæ and maxillæ became rudimentary, almost disappearing, while the legs utterly vanished. We see that a change of habits and surroundings, with corresponding changes in the form of the body and its appendages, both explain the metamorphosis of insects in general and also the differences between the larval forms of the different orders.

The following view will convey an idea of the larvæ of the Coleopterous families which in a general way correspond to the different larval stages of the Meloidæ; it being understood that the resemblances are suggestive and general, and not to be accepted in a too literal sense:

1. Primitive triungulin stage.	In Meloë more like Campodea than in Epicauta. Meloidæ. Stylopidæ.
2. Caraboid stage.	Cicindelidæ. Carabidæ, Dytiscidæ, Hydrophilidæ. Silphidæ, Nitidulariæ, Dermestidæ, Coccinellidæ, etc. Elateridæ, Lampyridæ, Telephoridæ, Cleridæ, Pyrochroidæ.
3. Scarabæoid stage.	Histeridæ. Scarabæidæ. Ptinidæ.
4. Coarctate stage, more or less cylindrical and apodous.	Cerambycidæ. Tenebrionidæ. Mordellidæ. Curculionidæ. Scolytidæ.

From the facts and considerations which have been presented, we are disposed to believe, subject of course to future correction, that the primitive Coleoptera were carnivorous forms, and that the scavenger and phytophagous forms have been derived from them, and are, therefore, secondary products, and as a whole of more recent origin.

The primitive form of beetle was probably a Staphylinus-like form, with a long, narrow body and rudimentary elytra, and carnivorous in habits. This has been suggested by Brauer,[1] though it occurred to us before meeting with his views.

[1] "So wird uns der Staphylinus als eine der ältesten Käferformen gelten," etc. Betrachtungen über die Verwandlung der Insekten im Sinne der Descendenz-Theorie, von F. Brauer, Verh. k. k. zool.-bot. Ges., Wien, 1869, p. 313.

Though the earliest beetle known is a Carboniferous weevil, yet we imagine the Coleopterous type became established in Devonian or Silurian times, when there may have existed the prototypes of the earwigs and beetles; for the two types may have branched off from some Thysanuran form. On the other hand, the primitive Coleopterous larva may have sprung from some metabolous Neuropterous form. The larva of Gyrinus has a striking resemblance to that of Corydalis and other Sialidæ, so much so that a terrestrial Carabidous form most probably was of Neuropterous origin, as indicated in our diagram.

Origin of the Diptera, Lepidoptera and Hymenoptera.—The Euglossata probably had a common origin in the first place from the metabolic Neuroptera. The Lepidoptera probably originated from the same group from which the Panorpidæ and Trichoptera branched off, and we agree with the opinion of H. Müller, who maintains that the Lepidoptera and Trichoptera "proceed from a common stock," though we should suppose that the Panorpidæ in their larval stage represented forms like the ancestral caterpillar.

The adult structure and larval forms of the Diptera show that they originated from nearly the same stock as the moths. The most perfectly developed Dipterous larvæ are those of the Culicidæ and Tipulidæ; these were probably the primitive forms; the other Dipterous larvæ, notably the larval Muscidæ or maggots, are degradational forms, and the lower Diptera appear to have been degraded or degenerate forms.

The case is different with the Hymenoptera. The saw-fly larvæ represent apparently the primitive larval form; and from their resemblance to caterpillars and Panorpid larvæ, show that the Hymenoptera and Lepidoptera may have had a common origin. The footless larvæ of the parasitic Hymenoptera are correlated with their parasitic mode of life, and the similar forms of the larval wasps and bees show that from disuse their mouth-parts and legs became aborted, and the immobile larvæ became short and thick-bodied. Hence such larvæ should be regarded as secondary, adaptive larval types. The high degree of specialization of the bees' mouth-parts, their concentrated bodies and 4-segmented thorax, with other characters, show that they are the highest, most specialized and modern of all insects.

Note.—It should be borne in mind that the embryo bee has a

pair of temporary abdominal appendages on each segment (uromere); so also has the Lepidopterous and Coleopterous embryo, which points back to a common, Scolopendrella-like type; this also possibly indicating a still earlier, worm-like, Peripatus-like ancestor for Myriopoda and Hexapoda at least, if not Arachnida. For previous discussions as to the origin of insects the reader is referred to the writings of Fritz Müller, Brauer, Lubbock, and the author.

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THE MINK OR HOOSIER FROG.

BY J. H. GARNIER, M.D.

THIS frog (*Rana septentrionalis*) seems comparatively unknown, and is found in localities far apart. It inhabits spring creeks and rivers, but in lakes and ponds of the purest water I have never seen it, nor captured a single specimen. It is quiet and solitary in its habits, never associating in numbers like the bull-frog (*R. catesbiana*), nor the green frog (*R fontinalis*). It makes its appearance in April. It was first named by Professor S. F. Baird, now Secretary of the Smithsonian Institution. Mr. Rice published some notes concerning it, which I have been unable to procure, and therefore furnish such particulars as have come under my own personal observation. It is a silent and unobtrusive species, and emphatically a river frog. It is never seen in fields nor woods, but as the observer walks by the banks of a brook, it seldom allows him to approach its lurking place, but, being very wary, dives into the stream, generally making for the center, where it seeks the cover of some friendly stone, buries itself in the mud, or conceals its body among the water plants. If taken in the hand it emits a strong odor of musk and garlic, or more properly the disagreeable scent of the mink; this is sufficiently powerful to adhere to the hand for a time, but soon passes away. It preys on water beetles and similar insects, but seems especially partial to the Julus family, having generally found it in the stomachs examined. Why it was termed "hoosier frog" I do not know, and I may be allowed to add the name of "mink frog," which has a positive meaning.

The tadpoles rest in little bays, or may often be seen in the most rapid current. If disturbed, like the adult, they dart into the middle, and it is no easy matter to secure specimens of the nearly per-

fected larva. They are very active and vigilant. I can aver that I have seen the larva dart into the river from the edge, at the distance of a rod or more from where I was standing, and have had no small trouble to secure even a few subjects.

The following measurements are the mean of twelve adults, in inches, and carefully correlated:

From end of snout to end of great toe	6⅜	inches.
From snout to vent	2¼	"
Breadth of head a full	⅞	"
Thigh in length	1¼	"
Leg do.	1¼	"
Tarsus do.	½	"
External toe do.	1	"
Second, or longest in all frogs, do.	1¼	"
Third do.	$\frac{15}{16}$	"
Fourth do.	½	"
Fifth do.[1]	⅜	"
Arm in length	⅝	"
Forearm do.	½	"
External finger do.	$\frac{5}{16}$	"
Longest finger, or second, do.	$\frac{9}{16}$	"
Third, or shortest, do.	¼	"
Thumb and pad do.	½	"
From internal canthus to end of nose	⅜	"
From angle of mouth to symphisis of jaws	⅝	"

This frog is easily distinguished from all others in North America by the peculiar minky odor and by the beautiful hazel-brown of the iris, features persistent in all specimens and in all stages when in life. These disappear, of course, in alcohol. The upper and lower lids are edged with a semi-transparent greenish border. The nostrils are small, black, and with a raised margin. The ears are dark brown, marbled with sooty black. Above each eye may generally be found a black blotch or spot, and a rectangular parallelogram of black on each shoulder. There is a slight band of raised skin from the angle of the mouth disappearing at the shoulder, but the lateral fold is absent in all stages.

The coloration of this species is peculiar, and is so persistent and so little varied in the many specimens I have examined as not to permit it to be confounded with any other. The back is a dark olive-green, mixed with sooty brown. There are sooty

[1] The foot when spread forms nearly a parallelogram, measuring to its outside edge 1⅛ inches long and ⅝ broad, which is large in proportion to the size of the species.

blotches of an irregular round form, especially towards the rump, each encircled with a dirty greenish ring or marbling. The head is of a more uniform greenish-brown. The upper lip green, shading to dirty white under the snout. Lower lip white. The upper surface of the thighs, legs and tarsus are blotched in two rows of spots, but not regularly banded, as also the arms. Soles of feet and palms of hands a uniform sooty brown. The upper surfaces of the external toe and the web attaching it to the second is of a sooty brown; the remaining three toes and webs are dirty white. The throat and all the inferior surfaces are of a beautiful paper white, with creamy or gentle grass-green tinges on the throat, giving a very pleasing effect. Occasionally a subject is found with a few scattered spots on the edges of the abdomen, or on the thighs, but as a rule the line of demarkation between the upper and under surface is very well pronounced. The lower eyelids are transparent, becoming white in alcohol. The stomachs of many have been examined by me, and they contained mostly Carabus, Julus and water insects, and on two occasions some little fish, chubs, if I remember correctly, about an inch long. Thus their food is like that of other frogs. On examining specimens taken on 20th July, 1883, the formation of the ova was considerably advanced. Like the bull-frog and green frog, it retires early to hibernate, and after the first sharp frost they all go to repose, and for about six or seven months are never seen.

In summer they may often be seen with the head and a bit of the back out of water, resting among plants on the borders of streams, and where the Potamogeton is in bunches, or the Ranunculus is in beds, the herpetologist may likely secure his specimens.

But if the frog once disappears, he generally keeps from view till all probable danger is past. It is useless to expect it to reappear at the spot it left, as it dives several yards, it may be, rods, before it stops. I have occasionally waited half an hour or more, watching one that has so dived beside a stone, in the current or otherwise. Perhaps they may have been really frightened, and the feeling of fear may have remained, or they may have followed some law of nature implanted within them in keeping concealed for such a protracted period. Occasionally I have heard their notes after they were secured and in my collecting case; but then it seemed truly a note of distress, and was in a different

tone and key from that rarely heard on the open stream. The loud-throated bull-frog and his equally noisy congener, the marsh or green frog, I do not consider indulge in the "chant amour" during the heat of the summer, as nobody ever saw them in coitu, at least I never did, although I have carefully watched and made many inquiries, both from whites and Indians. But how this takes place, or when, I cannot personally state for a fact.

The tadpoles of some Batrachia congregate in schools, as may be seen with the *Bufo lentiginosus*, *Rana catesbiana*, *R. fontinalis*, &c., but that of *Rana septentrionalis* is as solitary as the adult.

The tadpole has the odor of the frog, though not so strong; there is a band down the side, but it is not raised above the skin, being flat and a yellowish-green color, and disappears after the absorption of the tail. The beautiful soft hazel of the iris is there, and when looked at in sunlight the same mild expression of the face exhibits both innocence and repose.

There are certain peculiarities in the life-history and in external forms of these three Ranæ which so thoroughly agree that they may be separated into a group by themselves. These I shall endeavor to point out as concisely as possible:

1. They have no "chant amour," or love notes, in spring.

2. They retire early to hibernate with the first autumnal frosts.

3. They live in the water and lie in wait for their food, but do not hunt for it on land. They poise the body on any floating weeds, lie on the bank or any bit of stick or log that suits their purpose.

4. The tadpoles of *R. catesbiana* and *R. fontinalis* require two years to mature, and the mink frog requires the same period.

5. Adults in all three have no lateral fold, but merely a slight raising of the skin from the angle of the mouth, and which terminates or shades off on the shoulder.

6. The foot is broader in proportion than in the rest of the family, and the second toe is proportionally shorter, a peculiarity emphatically distinct, and can be seen at a glance by any one who takes the trouble of even a cursory observation. Webbed to extremities.

7. When captured they sometimes utter a cry of distress quite different from their ordinary croaking notes, and I have often

seen the bull-frog open his mouth and scream for over a minute, like a child in distress.

8. When they give their note it is always produced by inflating the throat pouch and suddenly expelling the air, whereas in *R. halecina* there is a pouch near the angle of the jaws, on either side.

9. They are all tinged, more or less, with yellowish-green on the chin, which soon shades towards the throat and breast, and on the belly is white, more or less, in many subjects most beautifully so.

There is thus an analogy in their life-history, and in their external conformation that at once forms them into a group by themselves, and makes a marked section. I am not aware, however, that there is any anatomical difference sufficient to make a genus. In fact I may be allowed to remark that anatomical variations are more frequent among the Batrachia than among any other class of the animal kingdom. There are species that even produce the ova fully fertilized, viz., the Siredon genus, before the larva is perfect. The bones in the feet of some species are never fully developed, and in others, closely allied, the bones are perfectly formed. But this is a subject in itself, on which much can be written, and at best such a subject can only end in theory and personal ideas.

The love notes of the Ranidæ, admirably termed "chant amour" by the French, is a point in their history I have seldom or never seen noticed in American works, and is a peculiar feature in this "*life-history*" that most emphatically marks whole sections. If I hear the notes of a frog, I can tell to what class it belongs, and when to expect its spawning season. On the 24th of June I collected a number of *R. septentrionalis* and placed them in a large, white, earthen vase. They remained quiet for a time, and I put in some chips and a quantity of Ranunculus. Next morning three couples were paired and lying at the bottom of the vase, and secreted among the Ranunculus. One pair were on the surface, but the female had been injured. It thus seems they accouple in the night, and immediately sink and hide. Occasionally there was a trivial chant amour from the last pair, evidently so given, but the others were mute. The *R. halecina* may often be heard croaking its lugubrious and dismal love notes from the bottom of some muddy ditch. That of the mink frog is a rapid

squeaking croak almost like the notes uttered by a toad when seized, with the finger and thumb, by its arm pits. I have since heard the same love cry late in the evening, on the banks of the stream, and have well recognized its peculiarly sharp ringing croak. The male seizes the female by the lower portion of the axilla, near the upper third of the dorsal vertebræ, but not by the lumbar regions. At this time the tinting on the chin and throat was a fine gamboge-yellow, and was deeper toned in some specimens than others, but not particularly more in the males than the females. In both sexes it was equally beautiful. I could not help being particularly struck by the extreme stillness of the pairs in coitu among the Ranunculus. Nothing seemed to induce them to move in any manner. They were at rest. I carefully examined since on all opportunities, and searched the streams and pools to find some in coitu, if possible, to observe them in their natural embrace, but as yet without success. As mentioned, the ordinary note of this frog is similar to that of *R. halecina*, but much more sprightly, and its note of distress is little different, yet is more sepulchral. I have seen it distend the throat on both sides of the tongue and give this peculiar cry, and there was a considerable depression in the center, over the glossal bones, which demonstrated a sack on each side.

Thus it may be justly inferred that after the female is grasped the pair sink to the bottom and conceal themselves from view and that they either bury themselves in the mud or seek the covering of water plants, after the manner of those in the earthen vase. It is likely some prompting of nature that thus makes them bury themselves from sight, to protect themselves from enemies that could, at that time, make them an easy prey, and in security perform their process of fecundation. I kept my specimens referred to for over a fortnight, but no spawn was deposited. To-day is the 30th July. On the 24th a fine lot was secured, with a number of tadpoles, and sent to the Smithsonian Institution. The color on the chin has much faded, and is now of a creamy-yellow, telling us that the spawning season is over. The same creamy color is seen when they first make their appearance in the beginning of May or in April. Specimens examined to-day are devoid of ova, are considerably collapsed, and the sides are sunk in. There is plenty of spawn in the streams; in some places it is seen adhering to water plants and waving in the

current; in others in bunches, in little bays, but in all places situated half way between the bottom and surface of the water. I also saw two similar bunches of spawn on the 24th June. It is therefore conclusive that *Rana septentrionalis*, the mink frog, spawns towards the end of July. On the 24th ult. I obtained several tadpoles, one a nearly perfected frog with only a small fragment of the tail to be absorbed; several had both legs and arms, and others the hind legs with the arms quite ready to make their appearance, and the skin confining them at the shoulders, transparent. Frogs now spawned cannot be completed this season, as there are plenty of tadpoles in October and in November of *R. catesbiana*, *septentrionalis* and *clamata*. They are seen, all of them, without limbs in spring, and at the present moment they are all three being perfected and assuming the imago, or perfected form. Thus it requires two years to perfect this little frog. From my own observations and from the proportional size of numerous specimens, it requires two years more to bring them to maturity.

Whether it was the effect of placing over a score together in the middle of June that caused their accouplement, I am unable to say, but there was no spawn deposited, which takes place at once in natural positions after coitu.

In studying the "life-history" of any species, it must be carefully traced, step by step. Analogy here is no criterion whatever, and often ends in conclusions far remote from facts—errors needing much trouble to rectify.

On the 2d of July a brook was examined that empties into the Lucknow river, and on a small rapid, shallow and broad, with a sandy and pebbly bottom, a cluster of tadpoles, of the species under consideration, was seen in a great disturbance, each individual on the outside endeavoring to force its way to some object in the general center. This proved to be a brook trout, *Salmo fontinalis*. It was covered with tadpoles, and nothing but the back bone was left, and a small portion of the head, sufficient to identify it. In another similar spot I disturbed a fresh colony and secured the skeleton of a chub, which had also been eaten, nothing remaining but the back bones, head and tail. This is now preserved in alcohol, and every atom of flesh had been eaten off, scales and intestines included.

About twenty of the tadpoles were taken home and placed in a large glass vase filled with rain water. They were in various stages of growth, some not much over an inch, and others with

the legs far advanced, and nearly four inches long. Anxious to discover if this frog, in its tadpole state, was essentially carnivorous, I dropped into the vase several small dead fishes. Next morning they were entirely consumed except the heads and the bones of the back. They always began to eat the soft parts of the belly and intestines, and then the rest of the fish. Thus I continued to feed them, and preserved several fragments of animals devoured. Several dead tadpoles of *R. clamata* were given them, the intestines of which were filled with mud and vegetable matter. So thoroughly carnivorous were these little creatures that no fragment of any part of the body or head was left except the engorged intestines. These relics I placed with the rest, and have them carefully preserved. I have opened a number of these tadpoles, taken from the stream and dropped in alcohol, and their intestines were often full of the common muddy matter found in all species, but on most occasions it was mixed with decaying animal matter, and small fish scales were visible when the matter was placed on the field of a microscope. I placed the soft vegetable substance, on which *R. clamata* feeds, in their jar, and they seemed indifferent to it, but as soon as a dead fish or tadpole was thrown in they immediately gave it their attention, invariably commencing to tear it open about the anus, and then the rest of the abdomen was quickly devoured, with all its contents. I never saw them wrangling over their food, as is always seen among little fish, nor on any occasion did one tadpole chase another.[1]

It may be justly asked, "Suppose a number of tadpoles of various species were mixed together in a vase of water, how could one species be distinguished from the other?" The tadpoles are a study in themselves, and it requires long observation, and close inspection, to tell each apart, as they are often so similar in stages that it is no easy undertaking. It would require many pages to point out all their differences, and even then the unscientific reader would be left in a cloudy labyrinth. However, let us point out the characteristics of this species, and how it may generally be known. It is larger in proportion to its size than any of the other American frogs when compared with the adult. The following are its measurements immediately before the arms are excluded from the skin, when the larva is at its greatest length, and is the mean measurement of nine specimens.

[1] This habit was first observed in the tadpoles of *Rana sylvatica* by Professor Baird.

Length from nose to extremity of tail	4	inches.
do. of body and head	1½	do.
do. tail	2⅝	do.
do. head	⅝	do.
End of snout to inner canthus	$\frac{5}{16}$	do.
Bronchial orifice to anus	½	do.
Breadth of tail at anus	½	do.
do. in centre	⅞	do.
The entire leg in length	1¼	do.

When the legs first begin to show their development they are a reddish-brown tint, and as they become more developed, become more spotted or banded, the upper surface colored as the adult. The coloration of this species, as now before me, is so different from all others I have seen that it may be looked on as specific, and I shall describe this pretty tadpole. The back is a deep grassy-green, with numerous sooty spots. From the external canthus to the insertion of the tail is an olive-yellow line, more or less pronounced in various specimens. The sides are green, with very many punctations of black, and a few spots of the same color scattered among them. The abdomen is white, and the separation of the colors on the sides is perfectly pronounced. Lips edged with black. The cheeks are irridescent green, and red, with a beautiful silvery tinge. The upper edge of the fin of the tail, as also the lower, are well marked with a line of black spots. Down the center, on each side, runs a line of black spots that continues to the end of the tail, but are variously developed in various specimens. The first half of the tail is most beautiful, deep, irridescent green, with many red and aurora-colored shades, that seem to melt into a silver plate beneath. The eye is a perfect hazel brown, or reddish, and, as already stated, is persistent in all stages of this frog. From the angle of the mouth, for nearly half an inch, is a well defined, narrow, black line. In young specimens, the throat and chin are mottled with sooty brown, as in almost all the other tadpoles, which gradually disappears with growth, and, towards maturity, entirely vanishes.

This tadpole is extremely active, and the tail much longer in proportion than any of our North American frogs with which I am acquainted, and, at the same time, narrower. A few days ago I saw several little heads sticking up among the beds of Potamogeton, and after much trouble secured two specimens. I saw one rush at, seize a large ephemera that came near it, and swallow it;

yet it had not more than the third of its tail absorbed. I have observed the same in *R. catesbiana*, the bull-frog, but have never as yet noticed that of the *R. clamata* do so. These three species remain silent after they first appear, until the rays of the sun warms the water they inhabit, when the last two render the swamps monotonously hideous, all night long, by an unceasing and seemingly senseless clatter. There is a peculiar reverberation in the notes of all frogs that renders it difficult to locate the exact spot from which it comes. I may mention in passing that I have stood on the mountain above Hamilton, at the head of Lake Ontario, and distinctly heard the bellow of the bull-frog at the further side of Burlington bay and in Dundas swamp, a distance of from four to six miles. These notes were weird and strange, and were truly a witchery on the air in the still summer night.

The tadpole of *R. septentrionalis* much resembles that of *Alytes obstetricans*, so well described by M. F. Lataste, of Paris, a highly distinguished herpetologist, whom I have the honor of numbering among my corresponding friends. He lately sent me his "Etude du Discoglosse," and among all the numerous works I have read on herpetological subjects this stands preëminently forth, for its scientific precision, acumen, and marked ability. In some points *Discoglossus pictus* seems to approach our Canadian *Rana septentrionalis*, which can be pointed out in some subsequent paper.

In regard to its geographical range it seems truly a northern form. It is mentioned in the local issue of the Bulletin of the U. S. National Museum, No. 24, by Dr. Yarrow, that there are specimens from Utah, Oregon, California, Moose river, Red river of the North, both the last in British America, and I can add Ontario and Manitoba. From this it is seen that it has a wide distribution, but being of a retiring nature it has doubtless been overlooked by collectors in many regions. Every animal has its place in creation to be for the general good. This seems to take its place, in the early stages of its career, as a scavenger of our streams, and in the adult, as keeping down the over-abundance of the insects that inhabit streams and their borders. I notice, also that it has been termed the "Rocky Mountain frog," but this name seems to me utterly untenable, as it does not belong to that region particularly, nor was it first discovered there; however, this is a point of not the slightest importance, and if any one is gratified with the name, it gives me pleasure to know it.

EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— Although the attempt is sometimes made in some quarters to look down upon the work of biologists and geologists, and to attempt to sever, in an artificial way, the pursuit of philosophy from that of pure science, we have always insisted that every thinking observer of nature in any department of science, is, in his way, a philosopher, and not a mere hod-carrier to the philosophic workman. Every monograph of a group of plants or animals, every life-history of an organized being, every detailed account of a fossiliferous bed is a brick, or at least straw for making bricks, for use by the generalizer in science, physical as well as natural. Physicists were formerly and very truly styled natural philosophers, but the term in these days is quite as applicable to the philosophic biologist in his quest for the origin of life-forms and his inquiries into the nature and origin of life itself.

The vivifying effects of the study of facts and of experimentation, as well as the debt owed by human culture to the inductive method, have been insisted on by M. E. Chevreul in an essay recently read before the French Academy. The author claimed that the experimental inductive method, as followed by Newton and his successors, is unquestionably the cause of the progress of the physico-chemical sciences, while the absolute *a priori* method, as conceived by Leibnitz, barred the way to all further progress. While Newton sought the proximate cause in order gradually to ascend to a possible first cause, Leibnitz started from the first cause, which for him was everything. "The study of the material world accessible to the senses, led, according to the German philosopher, to nothing real, while the spiritual world, without parts or dimensions, as represented by monads, numerical unities endowed from their creation with motion, was the object of pure knowledge, that is, of God himself."

The scientific mind is still in training; it is still in leading strings, and it will be long before it can let go of them and soar by *a priori* methods to reach ultimate truths. This is a healthy condition, and a genuine agnosticism in so far as regards scientific *a priori* deductions or guesses is at present, at least, an encouraging symptom of modern science.

RECENT LITERATURE.

HAECKEL'S VISIT TO CEYLON.[1]—The author is widely known for his popular works on biology and anthropology, and for his richly illustrated folios and quartos treating of Protozoans and Hydroids, as well as for his radical dogmatic views as an evolutionist and philosopher, but he now comes before the public as a charming narrator and most appreciative observer of nature in her broader aspects. This little book thus reveals a new side of the gifted author's mind, and one which does much credit to the Jena professor.

The impressions and sketches of tropical nature here recorded were obtained during a residence of nearly four months in Ceylon, and will be valuable as affording, from a fresh standpoint, views of tropical life and nature. Humboldt and Bates have given us pictures of Brazilian nature; Darwin has described the western slopes of the South American Cordilleras and the pampas, and Wallace has painted the gorgeous scenery of the Indian archipelago, while Hooker has drawn vivid sketches of the Indian flora and Himalayan scenery and animated nature, and now Haeckel has added a series of word-pictures of the Ceylon coast and highlands, their vegetation and animal life, which forms a fitting companion to the classical volumes which have preceded his.

Haeckel has afforded us vivid conceptions of the aspects of the Indian ocean and its life along the coast of Ceylon; of the dense, vigorous and magnificent forests mantling the shores of this favored island, as well as the primeval forests and scenery of the Cinghalese highlands, the haunts of the wild elephant, great gray ape and the Russa-deer, or elk.

Although a zoölogist, Haeckel never fails to record in enthusiastic terms the endless variety and richness of the tropical forest, which he studied with pencil in hand, and repeatedly photographed; until the impressions the reader obtains are perhaps more vivid than if the description had been prepared by a specialist in botany.

While we are treated to valuable and fresh descriptions of the coral reefs of Ceylon, Haeckel was somewhat disappointed in not finding more peculiar and new forms of marine life. He thus explains the reason:

"The extended research of the last twenty years, particularly the results of the *Challenger* expedition, have convinced us more and more that the living creatures of the different oceans are not, by a long way, so dissimilar as the terrestrial fauna of the different continents. My experience in Belligam afforded fresh proof of this. I found there, indeed, a considerable number of new and

[1] *A Visit to Ceylon.* By ERNST HAECKEL. Translated by CLARA BELL. Boston, S. E. Cassino & Co., 1883. 12mo, pp. 337.

some very interesting forms, particularly among the lowest orders of marine life: Radiolaria and Infusoria, sponges and corals, Medusæ and Siphonophora; still, on the whole, the creatures of the ocean-surface, as well as those of the coast waters, displayed a close affinity to the well-known marine fauna of the tropical Pacific, as, for instance, the Philippine Fiji groups.

"It is quite possible," he adds, "that other shores round India may be richer in various and peculiar forms than Ceylon. One unfavorable condition is the enormous and regular daily rainfall, which appears to reduce the saltness of the sea along the coast, and to check the growth of the marine animals."

The following quotation from a description of the primeval forest on the table land of Ceylon, is an excellent picture of tropical nature, and is a good example of Haeckel's style:

"But what is our sophisticated 'Waldeinsamkeit'—with a village a few miles away, at the best—to the real and immeasurable solitude which reigns in this primeval wilderness of the Cinghalese highlands? Here, indeed, we are sure of being alone with inviolate nature. I never shall forget the delicious stillness of the days I spent in the sombre woods and sunny savannahs at the World's End. * * * The sense of utter loneliness which pervades these wilds is greatly heightened by the fact that the animals which inhabit them show scarcely any outward signs of life. The wild elephant is, no doubt, to this day the monarch of the forest, but once only did I ever see any; and the great Russa-deer, or elk (*Rusa aristotelis*), which is said not to be uncommon, and of which I often heard reports, I never saw at all. These and most other natives of the forest are, in fact, chiefly or exclusively nocturnal in their habits, and during the day remain hidden in the deep cool coverts. Even the great gray ape (*Presbytis ursinus*), which is very common here, I but rarely saw, though I often heard its gruff tones early in the morning.

"The melancholy cries of some birds, particularly the green wood pigeons and bee-eaters are rarely heard excepting in the early dawn; at a later hour the gaudy jungle cock (*Gallus lafayetti*) is the only bird that breaks the silence. This gorgeous species appears to be nearly allied to the first parent of our domestic fowl. The cock is conspicuous for his gay and brilliant plumage, fine orange-brown ruff, and green sickle tail-feathers; while the hen is dressed in modest grayish-brown. The sonorous call of this wild fowl, which is fuller and more tuneful than the crow of his farm-yard cousin, is often heard for hours in the wood, now near, now distant; for the rival cocks compete zealously in this vocal entertainment for the favor of the critical hens. I could, however, rarely get within shot, for they are so shy and cautious that the slightest rustle interrupts the performance, and when once I had fired a shot the forest was silent for a long time after.

"I often sat painting for hours on some fallen tree-trunk with-

out hearing a sound. Insects are as poorly represented as birds, and excepting ants, they are singularly scarce; butterflies and beetles occur in small variety, and are, for the most part, inconspicuous. The murmuring hum of a cloud of small flies, with the accompanying murmur of a forest rivulet, or the soft whistle of the wind in the branches, is often the only sound that defies the deep silence of the spirit of the mountain.

"This adds to the weird impression produced by the fantastical forms of the trees of the primæval forest, the gnarled and tangled growth of their trunks and the forked boughs, bearded with yard-long growths of orange mosses and lichens, and robed with rich green mantles of creepers. The lower part of the tree is often wreathed with the white or strangely-colored flowers of fragrant epiphytal orchids, while their dark green crowns are gay with the blossoms of parasitic plants of various species. A highly characteristic ornament of these woods is the elegant climbing bamboo (*Arundinaria debilis*). Its slender grassy stems creep up the tallest trees, and hang down from the branches in long straight chains, elegantly ornamented with coronas of light green leaves. But here and everywhere else in the hill country, the most decorative plant is the magnificent *Rhododendron arboreum*, with its great branches of bright red blossoms. Next to this the most remarkable trees of these forests are species of laurel and myrtle, especially Eugenia, and some kinds of Rubiaceæ and Ternstræmiæ. We miss all the forms common in our European woods, and especially firs; this important family is entirely absent from Ceylon."

While the land leeches of Ceylon are an intolerable nuisance, Haeckel also speaks of the large worms, for which the hill country of Ceylon is famous: "they are the giants of their kind, five feet long, an inch thick, and of a fine sky-blue color." Mention is also made of the huge bird-catching spider (Mygale) which one of his hosts, an Englishman, had frequently seen in pursuit of small birds (Nectarinia).

The interest of the narrative is well sustained throughout, and the translator's work has been well done.

Wilson's Chapters on Evolution.[1]—While the author brings forward no new facts in support of his statements, he has prepared an argument and summary of facts taken from the works of other naturalists and presented it with much force and elegance of style. There are few specialists or general students of biology who could make a clearer or more readable exposition of the facts for evolution than this popular writer. The treatment is catholic and impartial, and the author is not wedded to Darwinism pure and simple, although from want of knowledge, apparently, of the views of some other authors, his quotations and views are taken chiefly from the works of Darwin and Huxley.

[1] *Chapters on Evolution.* By Andrew Wilson, Ph.D., F.R.S.E., F.L.S., &c. With 925 illustrations. G. P. Putnam's Sons, 1883. 12mo, pp. 383. $2.50.

The author prefaces his volume with the statement that "the chief aim of the work is to present, in a popular and readily understood form, the chief evidences of the evolution of living beings. * * * A considerable experience as a biological teacher has long since convinced me that the hesitancy with which evolution is accepted, and the doubt with which even cultured persons are occasionally apt to view this conception of nature, arise chiefly from lack of knowledge concerning the overwhelming evidences of its existence which natural history presents."

The plan of the book is logical and in a degree original. After stating the nature of the problem, Professor Wilson tells us what the study of biology is, and the nature of biological studies, and he notes, in passing, that "an important characteristic of scientific investigation exists in the fact that, having no prejudices to defend or prepossessions to consult, the man of science stands in no dread of the results to which he may be led, and is placed at no disadvantage when he replaces beliefs, however time-honored they may be, by the newer phases of thought to which his studies have led." Indeed, the author is bold, vigorous and thoroughly scientific in spirit, and while a grain iconoclastic, it is refreshing to meet with scattered remarks and hits at the pseudo-conservatism which would frown down the results of scientific investigation. For while reverent in spirit, the author well claims that "the willful folding of the hands in deprecation of scientific investigation, and the shutting of the eyes in a so-called 'orthodox' and slumbering ignorance of the facts of nature, is the procedure of all others best calculated to sap the foundations of religion itself. It is such ideas which Dr. Martineau, with his accustomed ability, has ably denounced when he says, 'What, indeed, have we found by moving out along all radii into the Infinite?—that the whole is woven together in one sublime tissue of intellectual relations, geometric and physical—the realized original, of which all our science is but the partial copy. That science is the crowning product and supreme expression of human reason.'"

The evidence from protoplasm as the fundamental life-substance, the evidence from rudimentary organs, from the tails, limbs and lungs of animals, the evidence furnished by the science of likenesses, the evidence from missing links, from development, from the life-history of insects; the evidence from the constitution of colonial or compound animals, the fertilization of flowers, the evidences from degeneration and finally from geology, these subjects are dealt with fully and satisfactorily in succession, the whole forming a compact argument neatly and forcibly presented, in a manner which the scientific expert will not only approve but find little to criticize.

Jordan and Gilbert's Synopsis of the Fishes of North America.—None among the Bulletins of the U. S. National Mu-

seum exceed, or even equal, in importance this that has lately been issued as No. 16. The fishes are a numerous class in the waters of North America, even when, as in the case of this volume, the rich fauna of Mexico is excluded. The long coast lines of two grand oceans, together with the extensive fresh-water systems, raise the total number of species admitted in this synopsis to 1340, including eleven marsipobranchs, sixty elasmobranchs and seven chondrostids. The Physostomi number 510, and the Physoclisti 747.

The classification adopted is founded principally upon that of Professor Cope, but is, in some respects, derived from that of Professor Gill. In accordance with the views of the former naturalist, the sub-class Ganoidei is, in the list, totally abandoned, but the two orders which represent this, are placed in a special division, Holostei, of equal rank with Physostomi and Physoclysti. We think this a judicious move, but cannot assent to the reduction of the Chondrostei to the same rank. In deference to the views of Gill, the order Apodes is accepted to include the Holostomi, the Enchelycephali and the Colocephali of Cope. The two great fresh-water families of Plectospondyli contain 317 species, while the Siluridæ are twenty-nine, all the Isospondyli number only ninety, the Haplomi fifty-eight, and the Apodes sixteen. Among the Isospondyli the Salmonidæ have forty-five species, while the Clupeidæ, and their near relatives, twenty-seven.

Among the numerous families of the Physoclysti, the Scombridæ and Carangidæ together have forty-one, the various divisions of the Percidæ about a hundred and eight, the Serranidæ twenty-nine, the Sparidæ an equal number, the Sciænidæ twenty-six, the Scorpænidæ twenty-three, the Cottidæ sixty-nine, the Blennidæ forty-eight, the Gadidæ twenty-six and the order Heterosoma (Pleuronectidæ) forty-seven species.

These numerous species are placed in 487 genera, which form 130 families — a number probably somewhat too large. On account of the delay in publication, copious addenda have grown up, and several new species are there referred to or described, but the list of species is corrected up to date.

The Percidæ of our authors exclude the Aphredoderidæ, Elassoma, the Centrarchidæ and the Serranidæ, but include the extensive group of darters, or Etheostomatinæ, so long fought for as a separate family.

The three species of Caulolatilus mentioned by Dr. Gill as occurring upon the Pacific coast (*C. anomalus* Cooper, *C. affinis* Gill, and *C. princeps* Jenyns) are all referred to the latter species, a view the correctness of which was proved by Lockington three years ago (Proc. Phil. Acad. Nat. Sci., 1880, pp. 18–19) and, by a parity of reasoning, the *C. microps* of Goode and Bean is referred to the well-known *C. chrysops.*

This work is a necessity to every working student of ichthy-

ology, whether occupied in the field or in the cabinet, and will, for many years to come, be the standard of reference. Its value is enhanced by the fact that it is the first large catalogue of species in which the attempt has been made to follow out the classification outlined by our leading ichthyologists, and founded on structural characters of more importance than the scales and spines which are the basis of the older classifications.

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Silliman, B.—Investigation of the scientific and economic relations of Sorghum Sugar Industry. A report to the U. S. Commissioner of Agriculture, Nov., 1882. Washington, 1883.

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Wadsworth, M. E.—The Bishopville and Waterville Meteorites. Ext. Amer. Jour. Sci., 1883.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

AMERICA.—At a recent meeting of the Royal Geographical Society, Mr. C. R. Markham read an article upon the explorations of Dr. Edwin Heath and others of the courses of the Amaru-mayu (Madre de Dios) and Beni. The streams which flow from the eastern cordillera for a length of upwards of 500 miles unite into these two grand rivers, which effect a junction in 10° 51′–42″ S. lat., and thence flow on to join the Mamoré and form the Madeira. The Beni in flood is said to carry as much water as the Mississippi, yet the Amaru-mayu is far larger, owing greatly to the fact that its main tributary, or rather true upper course, the Ynambari, flows for nearly 200 miles between the Andes and an isolated line of hills, and receives tribute on both sides.

The main stream of the Beni rises in the fertile Yungas of

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

La Paz, and it is thus the natural outlet for the trade of the commercial capital of Bolivia, as well as for the rich forest country, full of rubber, cinchona and other valuable products. Yet until the voyage of Dr. Heath, in 1880, this river had never been completely explored, and its lower course was so dreaded that rubber collectors who had established their camps nearer to its junction with the Madre de Dios than to Reyes, sent their gatherings to Reyes, thence by land to the Yacuma, and thence down the Yacuma and Mamoré. Many of the ravines and upper courses of the tributaries of the Beni are known, but the Madidi has not yet been followed down to its junction with the Beni.

Dr. Heath descended as far as "California," a recently formed rubber camp, in a good boat, but his exploration of the totally unknown region below this was undertaken and executed in an old boat caulked with corn husks and mended with bark and mud. At the junction of the Amaru-mayu and Beni, the former is 2350 feet wide, the latter 735 feet. Five miles below the river spreads out to a mile in width. The rapids were safely passed, the Mamoré reached and ascended, and in four months from his departure Dr. Heath was again at Reyes, where he was received with honors. In 1882 he ascended the Beni from Reyes to La Paz.

Only twice before had civilized men passed the mouth of the Amaru-mayu—the troops of the Inca Yupanqui in the fifteenth century, and Maldonado with his band of gallant Cuzco youths in 1861. The Amaru-mayu is to Cuzco, the Incas' ancient capital, what the Beni is to La Paz. The Inca Yupanqui knew its value, and a military expedition sent by him not only descended it, but reduced under the Inca rule the countries as far as the Beni.

After the Spanish conquests the rivers and the forest region around became a land of mystery, and though the people of Cuzco made many attempts to descend the Amaru-mayu, it was not until 1861 that the whole course was traversed by Maldonado and seven companions, four only of whom reached in safety the first Brazilian town.

ASIA.—M. Millot, once second in command of the Dupuis expedition to Tong-king, gives, in a recent number of the *Revue Scientifique*, a valuable account of that country. The kingdom of Annam consists of Cochin China and Tong-king, the latter of which was forcibly annexed in 1802, and is governed as a conquered country by the Annamese, whose rule, according to M. Millot, is so detested that the Tonkinese are ready at any moment to welcome the French as liberators. The area of Tong-king is rather more than a quarter of that of France; that of Cochin-China rather less. The principal streams are the Red river, which rises in Yunnan and crosses Tong-king from west to

east, its tributary, the Black river, the Thai-Bink, which with the Red river forms the Delta of Tong-king, the Song-Ma, the Song-Mo, and the Song-Giank. Most of these rivers are navigable, and they furnish great facilities for internal transport.

The climate from September to April is delightful, ranging from 7° to 15° C. During the remaining six months, which constitute the wet season, the temperature may rise to 35° C., yet at times descends to 16°. The greatest heats are tempered by the monsoon.

The lower courses of the rivers are densely peopled, and contain many considerable towns, the largest, Ha noi, with 150,000 inhabitants. The north and west are mountainous, and the Laotian tribes inhabiting these regions are more or less independent.

The soil is fertile, and almost every valuable product of tropical Asia grows or is cultivated there, though both in the cultivation and in the preparation of the products there is room for much improvement. The sugar-cane, cotton, rice, coffee, tobacco, tea, cinnamon, indigo, lac, essence of badian, ebony, rosewood, ironwood, sandalwood, and a still more highly odoriferous wood called *calambac*, are among its vegetable productions, while its stream and mountains are rich in gold, silver, copper, tin, iron, quicksilver, zinc and lead; bismuth and precious stones abound, and coal is found near the sea and the rivers. The animal world yields rich feathers, musk, wax and silk.

More than 500,000 Catholic natives wait the coming of the French, who, once in possession of Tong-king, could easily master Cochin-China, then deprived of its principal resources. Cambodia is already under the protection of the French, and the reunion of these would give them a territory four-fifths the size of France and more than half as populous. "Firmly seated here," says M. Millot, "we can watch the march of the events that will disintegrate existing Asiatic empires. * * * Saigon will supplant Singapore when the Isthmus of Kra, at the head of the Malay peninsula, is pierced by a ship canal, as it soon will be, since De Lesseps has the matter in hand."

AFRICA.—Nahdi Pasha, Governor of the Harrar, in the Galla country, has recently given some account of the region to the Société Khédiviale de Géographie. Two roads lead from Zeila to Harrar, a summer and a winter road. These unite at a point less than midway, and form one road through Biakabonda and the Gildessa pass. At Gildessa the Galla territory begins. The Galla sheikhs are responsible for the safety of travelers, and merchants and simple messengers pass safely from Harrar to Zeila. Between Zeila and Harrar the country is sterile, little known, and inhabited by nomad tribes; but at and around Harrar it is fertile and well cultivated. Each tribe of Gallas has its territorial limits

strictly defined. They are skillful workmen, work tolerably in iron and brass, and cultivate coffee, etc.

Commerce is carried on both by money and exchange in kind. Several Europeans are there, and one French and one Italian mercantile house.

M. Bazile Féris contributes to the *Revue Scientifique* a full account of the Slave Coast, part of the shore of the Gulf of Guinea, on which French and British interests come into collision. The coast is principally a narrow strip of land between the ocean and a lagoon which extends, with only two interruptions, which often disappear in the rainy season, from the River Volta, which parts Dahomey from Ashantee as far as the Benin. A bar makes access to the coast dangerous, but lagoons, canals and rivers facilitates internal communication. The principal products are those of the oil palm (*Elæis guineensis*), consisting of palm oil obtained by triturating the fruit, and the kernels of the fruit, from which a finer oil is obtained. Most of the commerce has for a long time been in the hands of the French, but in 1861 the English established their rule at Lagos, the principal port. The three chief races and languages are those of the Minas, the Géjis and the Yorubas, while the most widely spread European tongue is the Portuguese.

Geographical Notes.—The *Willem Barents*, sent in search of the *Dijmphna*, is to go to Vardoe, then to Waigatz, then into the Kara sea by the southern strait. She will then go to Archangel to learn whether any news of the missing ship has come, and afterwards return to the Kara strait and search the eastern coast of Waigatz and Novaya Zemlya.——The British are rapidly colonizing North Borneo. Tracts of land from ten to fifty thousand acres in extent have been taken up, and settlers seem to find the climate healthy.——Mr. Lawes writes from Port Moresby, New Guinea, of an exploration in which his wife accompanied him. The falls of the Rouna, 250 feet high, were visited. The natives (Koiarians) are rather smaller in stature and darker than the coast tribes, and are more hairy. Every village has its tree-houses or tree-forts, to which the inhabitants retire when attacked.——At a recent meeting of the Geographical Society of Paris the route of the proposed railway to unite the upper waters of the Senegal and Niger was traced out. The survey is completed from Kayes to Bafulabé.——The Argentine government has sent a force of 200 men to surround the Indians who hold as prisoners two survivors of the Crevaux mission. On his way their commander, Col. Sola, will endeavor to solve the problem of the existence of a river, the Chaco or Teyo, running parallel with the Pilcomayo.——M. Romanet du Caillaud, gives the population of Tong-king at more than eighteen millions.

GEOLOGY AND PALÆONTOLOGY.

Geology of Lower Merion and Vicinity.—My attention has just been called to the articles in the May number of the Naturalist by Dr. Frazer, and in the June number by Mr. Hall, on the Geology of the Chester valley and vicinity.

On page 523, Dr. Frazer has evidently written without examining the paper referred to (Acad. Nat. Sci. Phila. Nov., 1878), or the map, when he credits me with calling the belt S. of the limestone of Gulf creek the second and that at Paoli the third of "approximatively parallel beds," nor can I believe either he or Mr. Hall has ever examined the northerly belt which lies about one-quarter of a mile north of the outcrop of the belt east of Radnor station, and with a strike approximatively parallel.

If the serpentine outcrops between Radnor station and Paoli were described, as Dr. Frazer intimates, it is to be regretted that he did not refer to such descriptions. If they were not described, but were *well known*, is it improper to describe them, if they were erroneously set out in the only recent map published, to my knowledge, a map issued by one connected with the geological survey of the State, and of very recent date, when my paper was written, and this even if they were correctly delineated upon an *unissued* map?

Dr. Frazer thinks the connecting of the serpentine areas in Radnor, Easttown, &c., by a straight line curved at its eastern extremity a mere matter of judgment, while I do not understand him to dispute the correctness of my map, which shows the actual outcrops to be at angles with Mr. Hall's line almost throughout.

Few geological problems are difficult of solution if we may but fill a gap of two miles exhibiting constant surface indications of certain rocks by the imaginary existence of other rocks of which there are no indications.

Dr. Frazer states that much of the area called serpentine (in this region) has little to ally it to that mineral. Supposing the term serpentine to be used in its generic sense as a rock and as including steatite, talc, chlorite, &c., as distinguished from the adjacent gneiss, mica schist, and quartzite, and not in its restricted mineralogical sense, my observations do not agree with this.

Will he mention an outcrop in Lower Merion, Radnor, or Upper Merion at which one would find any difficulty in distinguishing the serpentine from the rocks bounding it? More than this, the rocks of some of the outcrops not shown in C 6 are precisely the same rocks which make the outcrops that *are* shown.

It may be that the sandstone and sand beds on the north flank of the South Valley hill and the associated iron ores are not Potsdam, but inasmuch as east of the Schuylkill the Potsdam occurs in precisely that position, this extensive deposit is at least worthy

of mention. Masses of sandstone of tons weight are not "sandy beds."

The remark as to the serpentine belt swinging around towards Chester I did not attribute to Mr. Hall. I was criticizing no individual. I was simply pointing out what my observation convinced me were conspicuous errors in Vol. C 6 of the Geological Survey.

If on page 525 it is intended to convey the impression that I was guilty of plagiarism, or at least of failure to give due credit to Dr. Frazer, I would offer as my apology the fact that my article was read December 23, 1881, and published in April, 1882, while his was read A. P. S. Dec. 15, 1882, eight months later.

The statement, page 528, that C 6 did not appear until late in 1882 is certainly erroneous. It bears the imprint 1881, and was in our libraries in December, 1881, hence the inference deduced, that the imprint on the Proceedings of the Section is an error is likewise a mistake.

Dr. Frazer says: "The map is quite obscure, and it is difficult to ascertain whether the section given lies in Chester or Delaware county."

The map is distinctly stated upon its face to be of *Lower Merion and vicinity*. The township lines between Lower Merion, Radnor, and Upper Merion townships and Chester county are all distinctly given and named upon the map. It was presumed that those interested in the subject were aware in what counties those townships were. The section line is clearly delineated as passing through Radnor township into Lower Merion.

I regret exceedingly if I have ignored the work of any one in this field, and if I have, I have sinned through ignorance and through supposing that in C 6 was to be found the knowledge of the region up to the date of its publication.

In natural science the first thing to obtain is facts, and in a region as geologically obscure as that south of the Chester valley every fact in regard to the rocks should be welcomed by every one desiring scientific truth rather than to sustain theories, whether such facts be ascertained by the members of the Geological Survey or by an obscure individual. Let the facts be examined critically, but if they are facts they should not be rejected, belittled, or ignored by one who does not state that he has examined into them and who does not seem to have read the papers in which they are set forth.

Two observers go over the same ground. One examines "*every outcrop* at least once," and publishes a map thereof; the other, while not pretending to have done such thorough work, describes many serpentine outcrops which the first did not, but finds mica schists in two places where the first found serpentine. Now it is very easy for a third, who has not examined these outcrops, to suggest that the only explanation is that what one ob-

server would regard as evidence of a serpentine outcrop another would not; but is such explanation, without inspection, scientific? It is certainly not highly complimentary to the gentlemen referred to to suggest that they cannot distinguish between mica schist or gneiss and serpentine. Will a similar explanation suffice for the omission of the very extensive porphyritic gneiss belt in Philadelphia and Lower Merion?

To set this question at rest, it is my purpose to exhibit at an early fall meeting of the Academy of Natural Sciences a suite of specimens from these outcrops, that those interested may see for themselves.

If it is seriously urged that a continuous valley clearly synclinal at each end is monoclinal in the middle of its length, it may not be so very unwise or unfortunate, as Mr. Hall asserts, to endeavor in that "middle to unravel a snarl in the tangled skein."

In defence of the Mineralogical and Geological Section, if defence be needed, I would only say that had all its *other* founders and members contributed as extensively to it as has its critic there would have been nothing to criticise.—*Theo. D. Rand, Phila., June 20, 1883.*

HULKE ON ICHTHYOSAURUS AND PLESIOSAURUS.—In the course of an anniversary address delivered before the London Geological Society in February of this year, the president, J. W. Hulke, took occasion to pass in review the homologies of the elements of the shoulder-girdle in the Ichthyopterygia and the Sauropterygia (Plesiosaurus, Elasmosaurus, Colymbosaurus, Nothosaurus). The coracoids and scapulæ are easily identified in both types, but the bones which in the latter order have been by some considered to be clavicles, are by their endosteal ossification and exact homology with the precoracoids of Chelonia, proved to be precoracoids; while the so-called interclavicle of the Sauropterygia lies on the upper or visceral surface of the coracoids and precoracoids, and shows traces of a primitive composition of two similar halves. These points seem to homologize it with the omosternum of existing Batrachia.

Thus the shoulder-girdle of Ichthyosaurus consists of coracoids, scapulæ, clavicles and interclavicle; while in that of the Sauropterygia, precoracoids and omosternum replace the two latter elements. Professor Hulke believes therefore that the association of the two orders in one sub-class is not expressive of a direct common ancestry. Good characters for distinguishing the apparently numerous species of Ichthyosaurus and Plesiosaurus are hard to find, and Professor Hulke believes that the characters on which the genus Pliosaurus is founded have little value. The Pliosaurian form of paddle was actually possessed by *Plesiosaurus manseli.* The "os intermedium" is traced from a position between the radius and ulna (epipodial) in Plesiosaurus to a mesopodial (tarsal or carpal) position in Ichthyosaurus.

SOME NEW MAMMALIA OF THE PUERCO FORMATION.—At a recent meeting of the Philadelphia Academy, Professor Cope stated that he had recently received from the Puerco beds of New Mexico remains of a number of individuals of the extinct mammal he had named *Periptychus ditrigonus*.[1] Besides jaws and teeth with permanent and temporary dentition in good preservation, the pelvis, femur and tibia are included in the specimens. These show that the species must be referred to the genus Conoryctes Cope, and render it very probable that the genus belongs to the family of the Periptychidæ. The absence of ungual phalanges prevents absolute certainty. The genus is near Periptychus, but differs in the one root and simple conic crown of the second true molars in both jaws, and the presence of cingular cusps of the superior molars, exterior to the external tubercles. *Conoryctes ditrigonus* has the molars of both jaws larger than those of the *C. comma*, and there is less difference in size between the posterior and anterior teeth than in that species.

The following new species accompanied the above: *Periptychus coarctatus*, *Pantolambda cavirictus* and *Zetodon gracilis*, gen. nov. The second named is the largest mammal of the Puerco epoch yet known, equaling a full-sized tapir in its jaws. The genus Zetodon was thus defined. The true molars consist of narrow crescents in two pairs, which are both concave towards each other, embracing a fossa. The posterior crescents soon unite on attrition, closing the fossa, while the anterior are well separated, and only unite by their anterior apices. Each has a small, columnar heel. Fourth premolar with the posterior pair of crescents only, which soon unite. The anterior pair is represented by a part of the external one which forms a narrow lobe. The heel is larger than in the true molar.

The position of this genus it is impossible to determine from the specimens obtained. It may be Marsupial or Condylarthrous, and, if the latter, one of the Meniscotheriidæ; but if not of these groups, its position is not likely to be in any known order of the Tertiary periods.

GEOLOGICAL NOTES.—*General.*—The reports of the British subcommittees of the International Geological Commission show that geologists are much at variance in their ideas as to the relation of the Permian and Trias to each other, to the carboniferous series below, and to corresponding series in other areas; that the existence of Miocene beds in Great Britain is at best doubtful, that the term "oligocene" is rather a convenience than the expression of a fact; and that exact agreement as to the titles and classification of the late pre and post-glacial strata is hopeless.——R. Lydekker, in his synopsis of the fossil vertebrata of India, records the presence of fishes in the "*Productus* limestone," which roughly

[1] Proceed. Amer. Philos. Society, 1882, p. 465.

corresponds to the Carboniferous of Europe; of Batrachia in the Trias-jura; and of Reptilia as low as the "Panchet group of the Gondwanas," probably triassic. Remains of birds have hitherto only been found in the Himalayan Siwaliks, and in one instance in Sind; while no traces of mammals have yet been detected below the eocene, and the great majority are pliocene.

Carboniferous.—M. Ch. Brongniart (Bull. de la Société Geol. de France) describes *Titanophasma fayoli*, an insect from Commentry, France, differing from recent Phasmidæ chiefly in the proportions of the parts of the thorax. The prothorax is equal in length to the meso and metathorax, while in recent species the mesothorax is longer than the other two parts. The total length of the insect was about 10″. M. Brongniart gives a list of 111 insects that have been described from carboniferous strata, including the present species and *Protophasma dumasii*, and adds that he has 440 additional species from Commentry, to be described ere long; out of this total of 551, 362 are Blattidæ.

Jurassic.—Professor J. W. Hulke has published in the Transactions of the Royal Society what he styles an "attempt" at a complete osteology of *Hypsilophodon foxii*, a British Wealden Dinosaur. As the restoration is made by so competent a hand from an extensive series of remains, in which the bones often maintain their normal connections, it may be accepted as authoritative. Hypsilophodon was adapted to climbing on rocks and trees, and its manus is more generalized and more lizard-like than that of Iguanodon. It is represented in a quadrupedal position. The manus, as shown by the figure of a forearm in the British Museum, has five digits.

Cretaceous.—M. L. Dollo, in a third note upon the dinosaurs of Bernissart, reproduces *Iguanodon bernissartensis*, reviews the arguments respecting its attitude when alive, and concludes in favor of its bipedal position and aquatic habits, thus accepting the views of both Owen and Cope.

Tertiary.—Bulletin No. 3, from the Princeton College Museum, contains notes upon the skull of the eocene rhinoceros, Orthocynodon, discovered in the Bridger beds in 1878. Professors Scott and Osborn consider this the earliest member of the rhinoceros group, and forms the family Amynodontidæ for the reception of it and Amynodon. Hyrachyus is stated to have been the common ancestor of four distinct lines of Perissodactyls. According to all present evidences, the rhinoceros group originated in North America.——Achænodon, discoursed upon in the same bulletin by Professor Osborn, is supposed by him to be the oldest of the pig family yet discovered. The carnivorous characters of the skull, in many respects quite ursine, are noted, and it is stated that many eocene Perissodactyls also have this peculiarity.——Another paper contains observations on

the brain casts of tertiary mammals, by A. T. Bruce. *Megencephalon primævus* had a comparatively large and well-convoluted cerebrum, apparently covering most of the cerebellum. On the whole, the casts proved that the brains of tertiary mammals were smaller and less convoluted than those of existing mammals. The last paper in the bulletin is by Professor Scott, upon *Desmatotherium guyoti*, a Lophiodont from the Bridger Eocene, closely allied to Hyrachyus; and *Dilophodon minusculus*, one of the smallest known Lophiodonts, and also closely allied to Hyrachyus.——R. Lydekker has defined the family Camelopardalidæ so as to include six fossil genera, commencing with the existing giraffe, and proceeding through the forms Orasius, Vishnutherium, Helladotherium, Hydaspitherium and Bramatherium, to Sivatherium, the length of the limbs and neck, on the whole, diminishing downward. This view differs from that of Mivart, who places Sivatherium near the prong-buck and Saiga. The long-limbed *Camelopardalis sivalensis* was a contemporary of the short-limbed Sivathere, so that the evolution of the long-limbed form must have been in an earlier epoch.

Post-tertiary.—Professor H. C. Lewis has published an abstract of a lecture on "The great Ice age in Pennsylvania." In it he states that "there is every proof that, ages ago, * * * the great Greenland glacier crept down so as to overspread the north-eastern part of America and the north-western part of Europe." He treats of this northern glacier as a sheet reaching from "Greenland to St. Louis, and from Alaska to New Jersey, so thick as to overtop Mt. Washington," estimates its thickness in New England at 5000 feet, and gives reasons for supposing that the melting of the glacier need not be longer than from 10,000 to 15,000 years ago. In a lecture upon the geology of the neighborhood of Philadelphia, he defines the alluvium, Trenton gravel, brick clay, red and yellow gravels, etc., and traces their history.

BOTANY.[1]

THE GROWTH OF PLANTS IN ACID SOLUTIONS. I.—The watering of plants with alkaline solutions, soluble phosphates, and organic extracts has been very extensively and variously experimented upon, but any comparative examination of a series of plants treated under the same conditions with acid waters has not to my knowledge been published. The experiments described below originated in an inquiry as to what extent acids would affect vegetation, and whether apprehensions aroused by the reported destruction of trees through acid precipitation from manufactures were justified.

The plants experimented with were specimens of the silver-leaf geranium, so commonly used in combination with the fish geranium in ornamental flower beds, both being varieties of the same

[1] **Edited by PROF. C. E. BESSEY, Ames, Iowa.**

species perpetuated by the gardener's skill and selection. Ten plants in very nearly the same conditions of growth, size and characters, were potted in good garden mold with manure, and were watered with solutions of nine acids and with ordinary rain water, the same solution being applied to one plant throughout the season uninterruptedly, and only in a few cases altered in strength. The rain water was used with one plant only, whose deportment was taken as a standard by which the effects of the acids were gauged, and it was used continuously with this one alone, an occasional application of water upon the rest supervening only after a very long treatment with acids. The acids employed were hydrochloric, nitric, sulphuric, formic, carbolic, tartaric, citric, tannic, and salycylic. The experiment began June 22, 1882, and lasted until September 6. The strength of acid solutions was 10^{cc} of acid, concentrated in case of the inorganic acids, and saturated cold solutions of the organic acids, in one litre of water. The solution of the salycylic acid was assisted by a slight addition of alcohol to water. The liquid volume used daily of these solutions for watering each plant was $115^{cc.}$

The organic acid solutions were strengthened on Aug. 1 to 40^{cc} of the saturated acid to one litre of water, with the exception of carbolic and formic, which were retained at their original strength, and the amount of both these latter, together with that of hydrochloric, nitric, and sulphuric acids, used to water the plants was reduced one-half. The behavior of these plants in detail was as follows, the plants being classed according to the *acid used:*

	June 25.	July 13.	Aug. 24.
Hydrochloric ..	6 full leaves.	6 full leaves; stunted.	5 full leaves.
Nitric..........	5 " "	4 " " "	2 " "
Carbolic.......	4 " "	2 " " "	None.
Formic.........	4 " "	6 " " "	5 full leaves.
Salycylic.......	6 " "	7 " " growing.	4 " "
Sulphuric......	7 " "	5 " " stunted.	2 " "
Tartaric.......	7 " "	9 " " growing.	9 " "
Tannic........	6 " "	9 " " "	9 " "
Citric..........	5 " "	7 " " "	7 " "
Water.........	11 " "	13 " " "	17 " "

From the first day of the experiment the first six plants, with the exception of the salycylic, were unfavorably affected by the acids used, but maintained a deceptive appearance of vitality by curtailing their expenditure of force in growing and applying it upon a maintenance of leaves. The doses appeared severe, but none of them died excepting the carbolic-acid plant, which very soon became debilitated and indigent, and the nitric-acid plant which died shortly after the experiment terminated. Of the rest the sulphuric-acid plant was the most thriving, then the hydrochloric-acid plant, and last, and just alive, the plant treated with formic acid. They were all stunted and depauperate in appearance. The remaining plants grew well and, except in fertility of

leaves, were not strikingly inferior in appearance to the water plant. The soils treated with inorganic acids first lost their retentiveness, and eventually all became similarly affected. The water plant alone formed a secondary radical branch.—*L. P. Gratacap, 77th st. and 8th ave., New York City.*

TUCKAHOE.—In the forthcoming volume of the Smithsonian report. Professor J. Howard Gore will have a paper on tuckahoe, or Indian bread. The word is a very common one in the sandy region of the Atlantic slope, but it does not apply to the same substance, being applied to Orontium, *Arum virginicum, Convolvulus panduratus* as well as to various fungi. The synonymy is quite formidable of the true tuckahoe, as *Pachyma cocos* (Fries), *Pachyma solidum* (Oken), *Pachyma pinetorum* (Horaninow), *Pachyma coniferarum* (Horaninow), *Lycoperdon solidum* (Clayton), *Lycoperdon sclerocium* (Nuttall), *Lycoperdon cervinum* (Walter), *Sclerocium cocos* (Schweinitz), *Sclerocium giganteum* (MacBride), *Tuckhaus rugosus* (Rafinesque).

The affinities, habitat, growth and formation and chemical composition are worked out with the greatest care, several tables of analyses being given.

"The most notable peculiarities of this substance are the entire absence of starch ('No fungus has yet been found to contain true starch,' Sach's 'Botany,' p. 241), the comparatively small amounts extracted by solvents, the gelatinous character of the cellulose, and the very small amount of albuminous substance. Nothing else yet analyzed has been reported to contain so large a proportion of pectinous matter. In ordinary fruits, such as are commonly used for making jellies, these pectin bodies seldom amount to ten per cent. According to Sach's Botany, 'the origin of colloidal pectin is still unknown.' Its nutritive value seems also to be entirely undecided. The older writers considered the pectin bodies of no value as foods, while later authors seem inclined to give them a value approximately that of starch. It seems certain that a diet of tuckahoe (*P. cocos*) alone would not sustain life, because of the lack of sufficient nitrogenous materials to repair the waste in the animal tissues; still, it might prove a valuable adjunct to highly nitrogenous foods.

"Various medicinal properties have been ascribed to *P. cocos,* such as an antidote to mineral poisons, for poultices on the ulcers that follow yellow fever, diarrhœa, cancers, and the most startling of all—the statement made in Hobb's 'Botanical Hand-book'—that it is aphrodisiac. It is easy to understand how these properties could be ascribed to tuckahoe—a representative name for all round or tuberous esculent roots—and now when *P. cocos* is the only root bearing the name of tuckahoe, it retains the traditional virtues of a large part of the Indian materia medica. From the large number of correspondents upon this subject, not one has been found who ever knew of any use to which it has been

put. So we may safely conclude that *P. cocos* possesses no practical value; but it is unsurpassed in interest from a botanical standpoint, especially since so little is known concerning it."

New Plants from California and Nevada, etc. II.—*Cymopterus corrugatus*, n. sp..—Nearly acaulescent, perennial; summit of the stipe bearing a whorl of usually three leaves and three or more sessile or long peduncled compound umbels; leaves ovate, leathery, veiny, pinnate or occasionally twice-pinnate, leaflets ternately or rarely pinnately parted or lobed, broadly ovate to cordate-ovate, lobes with a broadly cuneate base and rounded, very obtuse teeth, each with a white, very sharp mucro; petioles nearly equaling the blade, which is 3′–4′ long; root-leaves none; involucre absent or rarely present as a leafy bract; summit of the peduncle much thickened, and with the pedicels fleshy, involucels unilateral, scarious, of many scales united into a cup or almost entirely separate, scales tapering into a fine, thread-like point; flowers white, short-stalked; pedicels 6″–1′ long; fruit 3″ long, oblong, curved, with very thin corrugated wings.

This plant resembles *C. fendleri* and *C. glomeratus*.

Rose creek, Nevada, June, 1882.

Iva nevadensis, n. sp.—Annual, 6′–12′ high, widely branching from the base; strigosely pubescent all over with blunt, many-jointed white hairs; leaves about 2′ long, alternate, once to twice ternately or pinnately parted, very broadly obovate to oblanceolate in outline, all with a rather long cuneate base, petiole margined or winged, often 1′ long; inflorescence wholly axillary; heads white-hairy, rounded, one to several in a leafy bracted, short-stalked, erect or nodding, cluster; involucral scales leafy, usually three, somewhat united, in a single series; fertile flowers few, sterile numerous; corolla very hairy at tip; achene finely striate.

A peculiar and very interesting addition, requiring some modification of the generic characters. Hawthorne and Wadsworth, Nevada, June, 1882.

Cereus maritimus, n. sp.—Cæspitose, heads 5–200 in a bunch, which is often 2°–3° in diameter and 1° high; each plant cylindrical, ovate or in small specimens almost round, 1½′–4′ long, ¾′–1½′ wide; principal spines 4, straight, angled and somewhat twisted at base, 1′–1½′ long, beneath these are 8–10 very short spines which are either straight or hooked; spines light brown, except when young, then red at base, springing from a very short but copious wool; flowers light yellow, about 1½′ long and wide; petals oblanceolate or obovate, rounded, margin irregular; ovary obovate, sessile or short-stalked, covered with bunches of white or yellow, often hooked, short spines and crisped wool; fruit not mature.

Encinada, Mexico, April, 1882.

Other plants soon to be described are *Lagia jonesii* Gr., *Eri-*

trichium micromeris Gr., *Poa nevadensis* Vasey, *elongata* Vasey, *Stipa stricta* Vasey, *Festuca jonesii* Vasey, two other grasses and three ar four other phanerogams, as well as half a dozen species of new fungi. Some half dozen species are not yet named beside. Plants belonging to the same collection as new species, are *Breweria minima* Gr., *Draba unilateralis* Jones, *Rosa minutifolia* Eng., *Ribes viburnifolium* Gr., *Æsculus parryi* Gr., etc.—*Marcus E. Jones, Salt Lake City, Utah.*

Botanical Notes.—The June *Journal of Botany* contains a photograph, with a sketch of the life and labors of the late George Stacy Gibson, F.L.S., a local English botanist of considerable reputation.——In the same journal H. F. Hance describes a new species of Podophyllum, *P. pleianthum*, from the Island of Formosa. This makes the third species of this genus ; the oldest is the familiar May apple of our woods, *P. peltatum* Linn., the second is *P. emodi* Wall. Both these have solitary white flowers. The new species, however, has five or six dull red flowers, which hang in a pendulous group from the fork of the stem-leaves.——Dr. Cooke, in the June *Grevillea*, enters a most emphatic protest against the radical changes in specific names which the new views as to the real nature of the Uredineæ have brought in, in certain quarters. He has our hearty sympathy. We do not like, for example, to give up *Puccinia compositarum* for *P. flosculosorum* simply because Albertini and Schweinitz happened to name one of its stages *Uredo flosculosorum.* We wish the editor of *Grevillea* all success in his war upon this ultra stickling for strict application of the letter (not the spirit) of the law of priority.——We have received Arthur Meyer's brochure, Das Chlorophyllkorn in Chemischer, Morphologischer und Biologischer Beziehung (Arthur Felix, Leipzig). It contains ninety-one quarto pages of text and three fine lithographic plates. We hope to be able to notice it in full before long.——In the bulletin of the Minn. Acad. Nat. Sci., Vol. xi, Mr. J. C. Arthur publishes "Descriptions of Iowa Uromyces." As stated in the preface, "It is an attempt to clear up the synonymy, and to give a uniform and sufficiently full specific description to permit accurate identification, with critical and explanatory notes of the species belonging to this single genus." The descriptions have all been written directly from the specimens, and in so far as possible all the stages (*æcidium*, *uredo*, and *teleutospore*) are described with fullness. This is an attempt in the right direction, which it is to be hoped other students of the lower plants will imitate.——A. F. Foerste in the June *Botanical Gazette* describes an enormous poison ivy (*Rhus toxicodendron*) found near Dayton, Ohio, which measured some distance from the base seventeen inches in circumference. Its first branch was fourteen and a half inches in circumference, and another was about twelve inches.——From Houghton Farm Experiment Station Professor Penhallow has

issued a bulletin on Diseases of Plants, this number being devoted to (1) the normal condition of vegetable structure with reference to cell contents, and (2) peach yellows. The work appears to be well and carefully done. Four good colored plates accompany the second paper.

ENTOMOLOGY.[1]

THE OLD, OLD QUESTION OF SPECIES.—Dr. H. A. Hagen and Mr. William H. Edwards have drawn swords on the question as to how many species of Papilio of the *machaon* group we really have. As the question is one of opinion we do not expect either to convince the other. Dr. Hagen's method, which is too much based on the idea of fixity in species, would, if fully carried out, do away with all divisions; while Mr. Edwards's, though based on a more philosophic and correct view of nature, too often rates as species what the majority of naturalists would rate as varieties or races. In both directions the objects of classification may be perverted. There is, therefore, room for modification of the extreme views of both disputants. Meanwhile the debate gives scope to rhetoric and argument, and enlivens the monotony of the mass of descriptive matter that has hitherto prevailed in "Papilio," and rendered it rather dry to all but the describers. Dr. Hagen is certainly not less capable of sound judgment, because he has achieved distinction in other fields, and has made a specialty of another order. Rather should his judgment be the sounder on such a point. Nor have Mr. Edwards's views additional weight because of his well-known tendency to make species to be subsequently annihilated by himself or others, upon fuller knowledge. In default of actual proof by breeding Dr. Hagen has adopted the next best test, viz: the inseparability of the various forms. Just as extensive rearing from the larvæ in a given region almost invariably reduces the number of "species," and broadens our conception of the limits of specific variation in such region; so the comparison of extensive material from all regions emphasizes the principles of evolution by showing inseparable series and consequent genetic relationship. In this way not only species but genera often lose the definiteness they previously possessed, and we have only series left. Yet the value of separating this series into more or less constant sets known as varieties, species, genera, etc., with their sub-divisions, is too apparent to need argument, and only he who believes in the fixity of "species" in all time will be puzzled and baffled by the facts. Mr. Edwards will, therefore, have the support of entomologists generally, and shows, in fact, full knowledge of his subject and admirable humor in discussing it.

MYRMECOPHILA.—Prior to 1876 this interesting genus of little crickets was not known to occur in this country. Harris had

[1] This department is edited by PROF. C. V. RILEY, Washington, D. C., to whom communications, books for notice, etc., may be sent.

previously mentioned the genus as having possibly been seen on cucumbers, but the fact was left in doubt. In the early summer of that year a single female was taken by Mr. H. K. Morrison in Georgia, but under just what circumstances it was found he did not recollect. A notice of this capture was published by Mr. S. H. Scudder in the NATURALIST (XI. p. 190). Dr. Hagen also reports two specimens taken at Portland, Oregon, last summer. Mr. L. Brunner recently took additional specimens of this minute cricket in the vicinity of Washington, D. C., where it was by no means rare in the nests of *Formica rufa*, and a closely related species of ant that lives under the bark of rotten stumps. Of those taken one was a full-grown female, and the rest apparently immature. Thus far the male of this genus has not been positively met with, though we suspect that some of the supposed immature individuals are males. In Europe there are two species, of which only the females have been taken.

Mr. Bruner will name the species after Mr. Pergande, who has often met with it while looking for ants under decayed logs. These facts show that in this country the genus possesses the same habits as in Europe.

SALT-WATER INSECTS USED AS FOOD.—Mr. Edwin A. Barber, of Philadelphia, recently sent us some Diptera, which he received from Professor A. Peñafiel, that were taken from the Lake Tetscoco in Mexico. They are a species of Ephydra which Dr. Williston, to whom we referred the fragments, believes is *E. hians* Say, described from Mexico. Dr. Packard (*American Journal of Science and Arts*, February, 1871, p. 103–5) describes two species of this genus, viz. *E. californica* from Clear lake and Mono lake, California, and *E. gracilis* from Great Salt lake, Utah.

The insects of this genus are interesting not only by virtue of their inhabiting alkaline and saline waters, but also because the larvæ occur in such prodigious numbers, and form an extensive article of diet among the Indians of the West and Southwest. Professor W. H. Brewer, while working on the geological survey of California, found that the Indians gather from all around the vicinity of Lake Mono at specified seasons to collect the larvæ, which are washed up in windrows along the shores. From some interesting notes he has left with Dr. Williston it seems that this food is called koo-chah-bee. The worms are dried and sifted from the sand, the shell then rubbed off by hand, when a yellowish kernel remains like a small grain of rice, oily, nutritious, and not unpleasant to taste. Pulverized and made into cakes the food reminded Professor Brewer of the patent meat biscuit that was used during the war, more than of anything else he could liken it to. There are no fish or reptiles in the lake, but countless millions of these Ephydra flies rest on the water and on everything round about it. It is probable that the insect is most washed up by the waves when assuming the puparium

state near the surface, and that the yellow kernel referred to is the true pupa that dries within the puparium.

Alternation of generation in Aphididæ.—In a letter from our friend Lichtenstein, which has been for some time mislaid, he writes of Ritsemia:

"The true egg gives birth to the *Pseudogyne fundatrix*, which increases in size and shows six-jointed antennæ. The *Pseudogyne fundatrix*, without copulation, takes on the gall-like form. It is like the Neuroterus in the Cynipidæ, all are females,—no males. It produces gemmations of various sizes (pupæ), out of which issue the males and females. They copulate, and the true female (eight-jointed antennæ) takes on the gall-like form, and lays beneath herself the true eggs from which the fundatrix has to issue.

"You see it is precisely the history of Neuroterus (Pseudogyne) and Spathegaster (true female), and what is still more striking is that the young ones in Ritsemia remain in their parent's skin until they are full sized, and issue only as Pseudogyne, able to lay young at once, or as sexual individuals, able to copulate immediately. Is it not exactly like the Cynipidæ?"

Food-plants of Samia cynthia.—Mr. Birney deserves credit for his interesting observations on this subject recorded in the last number of the Naturalist, and we hope he will continue his observations and ascertain the cause of death of the sassafras and tulip-tree-fed larvæ. These trees are the favorite food of our Promethea larva, the nearest indigenous ally to Cynthia, and it is an interesting fact that while the former has never yet been found feeding on Ailanthus, its introduced ally (feeding chiefly on Ailanthus) takes also to the very trees which Promethea prefers. Cynthia has actually been bred to the imago from sassafras-fed larvæ, both at Washington and elsewhere, and is recorded as reared on Rhus, plum and Laburnum in Europe. Mr. G. D. Hulst has recorded it here from tulip tree, sassafras and wild cherry, while Mr. P. E. Nostrand (Bulletin Brooklyn Ent. Soc., II, p. 77) found it feeding voluntarily on willow.

Bitten by an Aphid?—Some time ago Mr. Samuel Swan, of New York, sent us the following letter. Specimens were subsequently forwarded, and proved to be *Siphonophora rudbeckiæ*, a large reddish Aphid common on Solidago and Rudbeckia. We think there must have been some mistake about the biting, which was probably done by ants or some other insect that escaped notice at the time:

A friend while crossing a waste lot last September gathered a bunch of golden rod, *Solidago rigida*. He soon felt his hand becoming very hot, and, on examining, ascertained that it had been bitten by the innumerable insects from the plant which covered his hand. The hand had the appearance of erysipelas, and was greatly swollen. He preserved some of the insects in alcohol, and I am now desirous of learning their name. If I send you one or two will it assist you in ascertaining the name, or do you already know the insect that infests that plant? Your reply will much oblige.

INJURY DONE BY COLASPIS TRISTIS.—This common beetle is, like its congener, *C. brunnea*, an almost universal feeder, and it is surprising that it has not before been noted as injurious to cultivated plants. I had yesterday, while on a farm near Herndon, Va., occasion to observe that this insect is capable of doing considerable harm to pear and peach trees by gnawing at the tender terminal shoots of the twigs. The tips of the twigs thus injured dry up and die. One of the peach trees I examined was full of such dead tips, there being hardly any healthy ones left.—*E. A. Schwarz, Washington, D. C., June 11, 1883.*

STEGANOPTYCHA CLAYPOLEANA.—Through the courtesy of Professor E. W. Claypole we received this spring, from Mrs. L. H. Lewis, some larvæ of the buckeye stem-borer, noticed in the November, 1882, issue of the NATURALIST (p. 914), and have obtained therefrom a number of perfect moths. The general resemblance of some of the specimens to others of *Proteoteras æsculana* is great; but with the perfect specimens the differences upon close inspection become quite marked. Claypoleana lacks the notch in posterior borders of primaries, the tufts of raised scales on the discs of same, and the peculiar tuft or pencil of hairs on the upper surface of secondaries in the ♂, between the margin and the costal vein. It is a shorter, broader-winged species; the ocellate spot is less distinctly relieved, the median oblique band more broken, the basal-costal portion paler and contrasted along the median vein with a dark shade which may be almost black, and which broadens posteriorly till near the middle of wing, where it is abruptly relieved by a pale space obliquing basally. By these characters the species is easily distinguished from æsculana, and it is withal a grayer species with the pale and dark shades more highly and abruptly contrasted. In an article by Professor Claypole, which appeared subsequent to our note (*Psyche* III, p. 367, issued Dec. 16, 1882), he states that Professor Fernald referred the species provisionally to Steganoptycha, Stephens, and this reference is evidently correct. None of the larvæ we received were boring in the leaf-stem, but rolled themselves up in the green leaves upon which they fed. It is doubtless more of a blossom and leaf feeder than a stem-borer. The larvæ were feeding during the first half of May and the moths issued during the first week in June.—*C. V. Riley.*

ZOÖLOGY.

NEW OBSERVATIONS ON HYDRA.—W. Marshall commences by stating his belief that the green color of *Hydra viridis* is not due to a symbiotic process, but is a property of the polyp, and in this he agrees with Professor Ray Lankester; of this species there appear to be several geographical races, as the forms mentioned by Baker, Trembly, Rösel, Pallas and Schäffer differ a great deal in size and in the proportionate length of the arms.

The young forms, just set free from their parents, have a remarkable power of movement in the ectoderm; this periodically thickens into tubercles which are best developed in two circular regions, but the number of tubercles is not constant. They may gradually disappear, the hinder ones completely, and the anterior often give rise to a mammæform papilla which may become greatly elongated and forked at the tip; a little later some of their cells become converted into spermatozoa, canals being given off from the central space protruded by the body-cavity, in which these elements are developed. Still later the hinder tubercles again become developed, either into buds (spring and summer), or ova (autumn). The author is unable to explain why the male elements appear so much earlier.

It would seem that the buds of Hydra were not at first developed in the interest of the species, but that they were merely blind sacks of the body cavity, which in time became provided with a mouth and tentacles, and were rendered capable of leading a free existence. In an examination of the causes of this phenomenon, we have firstly to note that when a Hydra is receiving more nourishment than it needs, it can only increase in extent by a system of folds, in other words, diverticula are developed. Were these buds developed irregularly on the anterior half of the body, the contractile power of the polyp would no doubt be affected. But these considerations do not explain why the buds get mouths; the explanation of which may possibly be that the body becoming too large, or the supply of food diminishing, the parent animal would no longer be in a position to feed the buds, which, therefore, must develop the organs of independent nutrition, and finally themselves break away and become independent of their parents. And it is, at any rate, certain that under experimental conditions the buds do break off earlier if the whole organism is subjected to less favorable conditions of existence.

A review and comparative account of the Hydroidæ leads to the belief that in Hydra we have to do with a form which has been partly degraded and certainly modified in adaptation to its fresh-water habitat.—*Journ. R. Micr. Soc.*

Kunstler on the Flagellata.—In the Bull. Soc. Zool. de France for 1882, J. Kunstler contributes some facts to our knowledge of the Flagellata. *Heteromitus olivaceus*, when treated with acetic acid, appears covered with filaments; and Butschli has described similar filaments in *Chilomonas paramœcium*. Butschli believes these filaments to be trichocystes, analogous to the nematocysts of Cœlenterata, and M. de Lunessan thinks them cilia that remain unseen during life in consequence of a layer of gelatinous protoplasm which is destroyed by the acetic acid. Our author does not accept either hypothesis, and states that they certainly do not exist in the normal state of Infusoria.

Prehensile flagella, often striated transversely, as though made by the union of corpuscles placed end to end, occur in the Flagellata. They can be seen in every individual that has been long submitted to energetic coloring reactives, and are always situated on the border of the upper lip. These buccal flagella are shorter than the locomotive flagella, since they are never longer than the body, while the filaments before mentioned may attain twelve times the body length. *Chilomonas paramœcium* and some other species, when in more or less putrified cultures, or in a bad light, become united into a zoöglea-like mass.

MODE OF APPLICATION OF THE SUCKERS OF THE LEECH.—G. Carlet has investigated this somewhat difficult matter by the use of the graphic method. He finds that if a leech be placed on a sheet of smoked paper, it progresses by the alternate fixation of the anterior and posterior suckers. That of the hinder one is made very simply and rapidly; the circumference being first applied, and then the central portion. That of the anterior is more complicated and less rapid; the leech commences by exploring the place to which it is going to fix itself, with the two sides of its upper lip; the anterior portion of the upper lip is then lowered, and then the lower lip is applied to the surface. The pharynx begins to be lowered, and the triangular contour of the sucker gradually becomes circular. The sucker then touches the paper in its center. From these observations it would follow that instead of beginning to fix itself by the center of its sucker and then depressing the edges, as has been generally believed, it is the edges which are first applied and the center which is last. When the leech detaches itself the edges are first raised, and then the center.—*Journ. R. Micr. Soc.*

THE DEVELOPMENT OF ASCIDIANS.—Some points in the development of one of our common Ascidians have been examined by Mr. J. S. Kingsley, whose paper appears in the Proceedings of the Boston Society of Natural History, illustrated with a plate. The species examined was *Molgula manhattensis*. The larvæ and young are very tenacious of life and will live for weeks in a dish without any change of water. The embryos do not leave the body of the parent until the tadpole state is attained, when they may frequently be seen passing out of the atrial opening of the adult. The segmentation went on as observed by Lacaze-Duthiers in an European species of Molgula, but the general development of the latter species is more abbreviated and accelerated than in our species, whose development is like that of the normal form, such as *Ascidia ampulloides*, described by Van Beneden.

THE FOOD OF THE CRAYFISH.—In his "Economic Relations of Wisconsin Birds," Mr. F. H. King remarks that crayfish have been so little studied in regard to their habits that an economic

position cannot be satisfactorily assigned them at present. He then quotes as follows from a letter from Professor W. F. Bundy: "Crayfish feed on worms, small mollusks, insects that fall in their way, small fish, and in general any kind of animal food, especially carrion. They are industrious scavengers. This latter item, with the additional ones that they form a not inconsiderable part of food for fish, and their damage to meadows by burrowing, indicate where they come in the most direct relation to human interests." The river species, adds Mr. King, he regards as beneficial. Those which burrow in the meadows, building mud chimneys which become sun-baked and interfere quite seriously with mowing, he is in doubt in regard to, but inclines to the opinion that their services as scavengers more than offset the damage they do. Crayfish are preyed upon to a considerable extent by various species of herons and some other birds.

THE BOTTLE-NOSE WHALE.—There has been considerable confusion respecting the species of genus *Hyperodon,* since Dr. Gray described and figured *H. latifrons* from a skull found at the Orkney islands. The characters upon which Dr. Gray's species, afterwards made into a genus entitled Lagenocetus, was founded, certainly seemed important enough to be specific, since the ascending part of the maxillary, which in skulls referred to *H. rostratus* were thin, were in the type of *H. latifrons* very thick, nearly touching each other in front of the blower, and higher than the hinder part of the skull. Nevertheless Professor Eschricht expressed his opinion that *H. latifrons* was only an old male of the ordinary *rostratus*, *bidens*, *butzkopf*, etc. (as it had been variously called). Dr. Gray, in rejoinder, asserted that the fisherman who procured the head had assured him that it was that of a female gravid with young. Thus the matter rested until last year, when the second species was definitely disposed of by the observations of Captain Gray, before whom the subject was brought by Professor Flower.

Captain Gray, observing the frequency of this Ziphioid in the seas between Iceland and Spitzbergen, harpooned several and brought back their oil. This, upon analysis, proved to so closely resemble that of the sperm whale as to be probably of equal value for the special purposes for which sperm oil is used. This, with the discovery that spermaceti existed in the head, induced Captain Gray to devote himself to the capture of bottle-noses.

A series of skulls and of skeletons brought back by this gentleman showed the gradual increase of the maxillary elevations in the male, until in old individuals the head takes on a quadrangular box-like form, squarely truncate in front, but differing from that of the sperm whale in the presence of a small beak below it.

According to Captain Gray's notes, this toothed whale attains a length of thirty feet and then yields two tons of oil and two hundred weight of spermaceti. It feeds upon small cuttlefish, and in pursuit of them stays below longer than others of its order, a fact which makes it difficult to kill. After running out 700 fathoms of line, and remaining below two hours, an old male will come up so fresh as to require a second harpoon, and will attack the boats with head and tail. So strong are the muscles of this whale that it can not only leap clear out of water, but can guide itself in descending so as to plunge head first, instead of falling helplessly sideways like the larger whales.

A SQUEALING TOAD.—On the 24th of May, an unusually warm day for this region, while walking on the University grounds at Berkeley, I noticed something hopping along on the hot gravel of the road; upon close inspection it proved to be a toad. It was heading for a small bunch of weeds for shelter; as it squealed like a mouse when I first poked it, I repeated the poking several times, taking caie not to hurt it; with each poke it squealed as at first; if my eyes had been shut, I should have supposed the squealing to have been made by a mouse. After experimenting for a few minutes, I finally placed it in the shelter of the weeds and walked on.

Though not a specialist as regards toads, I have had the honor of an acquaintance with these animals for many years, but this squealer is the first I have met with.—*R. E. C. Stearns, in Cultivator's Guide.*

THE SPURS AND CLAWS OF BIRDS' WINGS.—In a recent issue of the Proceedings of the Boston Society of Natural History, J. A. Jeffries has an interesting article on the claws and spurs of birds' wings. A spur consists of a bony core on the anterior side of the arm, surrounded with connective tissue and covered with a thick horny coat, while a claw upon a wing is the homologue of that upon a foot, that is, it is a horny case surrounding an ungual phalanx. The spur occurs in birds so widely separated that it cannot have been inherited from a common ancestor. Claws are of far more common occurrence, but are inconspicuous, and useless as weapons, but are of value in classification. They are on the end of the first finger of many birds, and much more rarely on that of the second. A first finger with two phalanges almost or quite always bears a claw on the last, but a second finger with three phalanges may be clawless. Accordingly the ancestors of birds had a two-jointed first finger, and a three-jointed second finger, and agrees so far with that of reptiles and mammals. A list of the phalanges of the hand, and spurs and claws found in different groups of birds is given, and it is pointed out that the number of phalanges is least, and the claws are absent, in what are usually considered the highest

groups of birds. The writer points out that it is unadvisable to put birds with a complete phalangeal schedule as descendants of those with an imperfect one, as has sometimes been done.

Hybernation of the Spotted Gopher.—This is an interesting little animal which is still met with around my residence here, and I do not know whether its natural history has been well written up. Twenty-five years ago, while digging for a private road on a sidehill with a southern exposure, in the month of March, I dug out one which was rolled up in a nice hibernacle lined with dried grass. It felt cold to the hand when I took it up and appeared to be quite insensible. I took it into the house where the temperature of the room may have been about 70° Far. In a short time it began to show signs of animation, and in half an hour was skipping about the room as lively as in midsummer. I regret exceedingly that I did not observe the action of the heart while in the torpid state and the pulse, and the increase, if any, as it got warmer and was finally restored fully to animation. This was the only opportunity I ever had to make such observations.

It has a stout neck and shortish tail like most of the marmots, with rather regular rows of white spots along the back and upper sides. It is not figured by Anderson and Bachman, and I do not remember to have seen it described.—*J. D. Caton, Ottawa, Ill.*

Zoological Notes.—*Protozoans.*—MM. Munier Chalmas and Schlumberger have lately read before the French Academy some fresh observations on the dimorphism of the Foraminifera.

Echinoderms.—A most interesting crinoid has been described before the Royal Society by P. H. Carpenter. Among the collections of the *Challenger* expedition is a Comatula which was dredged at a depth of 1800 fathoms in the Southern sea. Although it is unusually small, the diameter of the calyx being only $2^{mm.}$ the characters presented by this form are such as to render it by far the most remarkable among all the types of recent crinoids, whether stalked or free. Of the four distinguishing characters of this crinoid, which Carpenter calls *Thaumatorcinus renovatus,* one appears in one or perhaps in two genera of Comatulæ, another is not to be met with in any Comatula, though occurring in certain stalked Crinoids; while the two remaining characters are limited to one family of the Palæocrinoids, one of them being peculiar to one or at most two genera which are confined to the lower Silurian rocks. Their appearance in such a specialized type as a recent Comatula is therefore, he adds, all the more striking.——In this connection may be mentioned the French deep-sea expedition of the *Talisman*, which sailed June 1st, and was to visit the Canaries, Cape Verd islands, Azores and intermediate waters.

Worms.—At a recent meeting of the French Academy L.

Joliet read some observations on blastogenesis and alternating generations in Salpa and Pyrosoma.

Mollusks.—R. Bergh continues in the Verhandlungen of the Imperial Zoölogical and Botanical Society of Vienna his elaborate contributions to a knowledge of the Æolidæ, a group of nudibranchs, accompanied by excellent plates.

Arthropods.—In his comparative study of the arachnofauna of Abyssinia and Shoa, published in the report of the Lombardy Royal Institute of Science and Letters, Professor Pavesi describes thirty new species of spiders, for one of which (*Chiasmopes*) he establishes a new order.——Count Keyserling contributes to the Verhandlungen of the Zoölogical Botanical Society, of Vienna, the fourth part of his "New Spiders from America;" a few species are described from Colorado, the remainder from South America.——C. Nörner describes very fully, in the same Verhandlungen, *Analges minor*, a new mite living within the quills of the hen.——The researches on the fauna of the Black sea of Rathke, Nordman and others, made as far back as 1823, revealed only forty species of Crustacea, and led to the opinion that this sea was barren in life of this sort. But 160 species have lately been added by a number of Russian observers, of whom the most prominent is Bobretsky. Czerniawsky now affirms, says *Nature*, that the Crustacean fauna of a single bay of the Black sea, the Bay of Yalta, is richer than that of the whole of the Belgian coast. This fauna was by some authors supposed to be like that of the northern seas, but in a notice published in the last volume of the Mémoires of the Kieff Society of Naturalists, M. Lovinsky points out the close relationship of the Black sea crustacea with those of the Mediterranean sea, the latter having its northern forms as well as the Black sea. But the Black sea fauna appears to be a part of the fauna of the Mediterranean basin, slowly modified by the medium it inhabits; this opinion is supported by the kinship of several Black sea forms with those of the Mediterranean and the Red sea, and by the richness of the Black sea fauna in more varieties and in such forms as are purely local, the prevailing types of the fauna being still the cosmopolite ones. The Black sea fauna would thus be but a part of the Mediterranean fauna, but much impoverished, and modified to a great extent by the variety of local conditions.

Vertebrates.—At a recent meeting of the Berlin Physiological Society, Du Bois Reymond communicated a short notice from a letter of Professor Babuchin's to him, which contains a fact interesting as showing the power of adaptation to their surroundings that electric fish possess. Professor Du Bois Reymond had previously called attention to the fact that the electric eels and Malapterurus that live in badly-conducting fresh water show, in as far as they have accommodated themselves to this medium, a

considerable development of their electric organ in length compared with the small size of its transverse diameter; whereas in the electric rays that live in sea water, which is a good conductor, the electric organ has a greater transverse development, consequently the electromotor powers of the electric organs of the electric eel and Malapterurus on the one side, and of the electric ray on the other, were to one another inversely as the conductibility of the surrounding media. The measurements of Humboldt and of Sachs of growing electric eels had shown that in their growth the electric organ increased proportionally more in length than in transverse diameter, which is a teleological adaptation to the badly-conducting fresh water. Now the above-mentioned note of Professor Babuchin contained the communication that in growing electric rays the electric organ increased proportionately much more in breadth than in height; this is likewise in conformity with the adaptation to the sea water, which is a good conductor.——Some observations on the embryology of the teleostean fishes by J. S. Kingsley and H. W. Conn, appear in the Memoirs of the Boston Society of Natural History (April, 1883). It is preceded by a full bibliography and concerns the development of the embryo of the cunner (*Ctenolabrus cœruleus*), whose eggs are found very abundantly floating on the surface of Massachusetts bay. The observations made are recorded under the head of maturation of the ovum, segmentation of the yelk, formation of the germ-layers, notochord and neural cord, optic bulbs and protovertebræ. It appears that the eggs hatched within forty-eight hours after impregnation. The memoir is accompanied by three plates.——The Verhandlungen, issued in 1883, of the Vienna Zoölogical and Botanical Society, contain the following ornithological papers by A. v. Pelzeln: on a collection of birds from Borneo, on a collection from Ecuador, and on Dr. Emin Bey's third sending of birds from Central Africa.——A hand-book to the birds of British Burmah, by E. W. Oates, and Seebohm's History of British birds, are recent ornithological works.——In his lecture on whales, past and present, and their probable origin, reported in *Nature*, Professor Flower gives us the first exact information the ordinary reader is liable to meet with as to the facts regarding the development of teeth in the embryo baleen whales. The whalebone whales are distinguished by the entire absence of teeth, at all events after birth. But it is a remarkable fact, first demonstrated by Geoffroy St. Hilaire, and since amply confirmed by Cuvier, Eschricht, Julin and others, that in the fœtal state they have numerous minute calcified teeth lying in the dental groove of both upper and lower jaws. These attain their fullest development about the middle of fœtal life, after which period they are absorbed, no trace of them remaining at the time of birth. Their structure and mode of development has been shown to be exactly that characteristic of ordinary

mammalian teeth, and it has also been observed that those at the posterior part of the series are larger, and have a bilobed form of crown, while those in front are simple and conical, a fact of considerable interest in connection with speculation as to the history of the group. It is not until after the disappearance of the teeth that the baleen, or whalebone, makes its appearance, which, as is well known, consists of a series of flattened, horny plates, several hundred in number, on each side of the palate, separated by a bare interval along the median line. This baleen Flower regards as nothing more than the highly modified papillæ of the lining membrane of the mouth, with an excessive and horny epithelial development, as seen in the row of papillæ on the free edges of the laminæ of the ridges of fibrovascular tissues in the palate of oxen and especially the giraffe.

PSYCHOLOGY.

REASONING POWERS IN THE CAT.—My brother-in-law, Mr. Benjamin Hall, had a large emasculated cat which showed some characteristics which may be worthy of record.

He was much attached to his master and followed him in his walks about the fields after the manner of a dog. On one occasion he was thus conducted to a considerable distance from the house into the prairie, where a considerable number of the spotted prairie gopher had colonized, invited, no doubt, by the favorable condition of the soil for their burrows. The cat soon captured one of these, which he brought to his master, whose caresses and commendations seemed to be highly gratifying to him. The cat then made a breakfast of his capture.

Very frequently after that the cat would resort to this favorite hunting ground, but would never eat his game on the spot, but would bring it home and exhibit it in triumph, and, after being duly caressed, would quietly go to some convenient, retired place, and make his meal.

But all this shows strong attachment and a love of approbation in a high degree.

On another occasion this cat showed a much higher degree of intellectual endowment. One day he followed his master among some trees. On the outer end of a bough a young robin was observed about twelve feet from the ground. The bird was soon observed by the cat, who deliberately surveyed the situation for a few minutes and then stealthily repaired to the foot of the tree and began to ascend it on the side opposite the bird, completely concealing himself from the bird till he reached a large limb which projected out over the bird. Slowly and cautiously he crept along the upper side of this limb till nearly over the bird, when he gave a spring, caught the bird in its flight, and lit upon the ground and ran away with his prize. He had been often reproved for catching birds; so, as if conscious he had done wrong, he did

not present himself for commendation as he did when he had caught a gopher. Plainly he had learned something of the principles of right and wrong. In the capture of the bird he executed a deliberately formed plan, which manifested a very considerable degree of reasoning powers beyond that of inherited habit.—*J. D. Caton.*

An Elephant's Revenge.—One of those pests of society, "a practical joker," visited a caravan in a West of England fair, and tried his stupid tricks upon an elephant there. He first doled out to it, one by one, some gingerbread nuts; and, when the grateful animal was thrown off its guard, he suddenly proffered it a large parcel wrapped in paper. The unsuspicious creature accepted and swallowed the lump, but immediately began to exhibit signs of intense suffering, and snatching up a bucket handed it to the keeper for water. This being given to it, it eagerly swallowed quantities of the fluid. "Ha!" cried the delighted joker, "I guess those nuts were a trifle hot, old fellow." "You had better be off," exclaimed the keeper, "unless you wish the bucket at your head." The fool took the hint only just in time, for the enraged animal, having finished the sixth bucketful, hurled the bucket after its tormentor with such force that, had he lingered a moment longer, his life might have been forfeited. The affair was not, however, yet concluded. The following year the show revisited the same town; and the foolish joker, like men of his genus, unable to profit by experience, thought to repeat his stupid trick on the elephant. He took two lots of nuts into the show with him, sweet nuts in one pocket and hot in the other. The elephant had not forgotten the jest played upon him, and therefore accepted the cakes very cautiously. At last, the joker proffered a hot one; but, no sooner had the injured creature discovered its pungency, than it seized hold of its persecutor by the coat-tails, hoisted him up by them, and held him until they gave way, when he fell to the ground. The elephant now inspected the severed coat-tails, which, after he had discovered and eaten all the sweet nuts, he tore to rags, and flung after their discomfited owner.—*Chambers's Journal.*

ANTHROPOLOGY.[1]

The Charnay Collection in Washington.—The following is from Mr. A. Thorndyke Rice, editor of the *North American Review*, to Professor Baird, May 31:

"From advices received from Mr. Désiré Charnay, and dated Paris, May 12, I learn that casts, taken on the spot by means of the proces Lotin de Laval, of many of the most notable inscriptions and bas-reliefs existing in the ruined cities of Mexico and

[1] Edited by Professor Otis T. Mason, 1305 Q street, N. W., Washington, D. C.

Central America, are now in transit to this country, having been shipped from Havre, on the 10th inst., on the steamer *Labrador.*

"These casts, a catalogue of which is enclosed, are duplicates of those now on permanent exhibition at the Trocadero, Paris, in a building specially appropriated to their accommodation. They have been made with the express purpose of being exposed to public view, and kept permanently in the Smithsonian Institution, under such conditions as will afford to students of American antiquities the fullest opportunities for studying these products of indigenous art and these hitherto indecipherable inscriptions.

"The expedition to Central America, of which these casts are the result, was equipped and maintained in the field for about two years at the joint expense of Mr. Pierre Lorillard and the Government of France, and under the auspices of that Republic and the United States. I have myself taken a profound interest in the progress of its labors, and have had the general direction of the work. It will therefore be exceedingly gratifying to me, as well as to Mr. Lorillard, to receive from you the assurance that this unique and valuable collection of American antiquities will be assigned such a place in the Smithsonian Institution as its exceptionally interesting character merits.

"Several applications for these casts have already been made to us by various public institutions in New York, but in view of the national character of the expedition, it is desired first to offer the fruit of its labors to the Smithsonian Institution.

"An early answer will oblige, because of the early arrival of the collection, and of the expected coming from France of an expert for the proper arrangement of the casts."

Under date of June 4, Mr. Rice writes:

"I am sincerely gratified to learn that the Smithsonian Institution tenders so cordial a reception to the Lorillard collection. Perhaps I ought, in my former letter, to have given some approximate estimate of the size of these casts, so that you might be able to decide whether the space now at your command in the institution is sufficient to afford them opportunity for effective display. Many of these bas-reliefs and inscriptions are from eight to ten feet high, by six or eight feet broad.

"I shall be obliged if you will kindly advise me immediately whether the great size of these monuments is likely to present any obstacle to their fitting accommodation in the Smithsonian.

"The artist charged with the duty of setting them up, sailed from Havre on the 26th ult., in the steamship *St. Germain.*"

LISTE DES MOULAGES ENVOYES A WASHINGTON.

1. Bas-relief, Indian, venant d'Oocosingo.
2, 3, 4, 5. Pierre de Tizoc—4 pieces.
6. Grand fragment—de Tezcoco.
7. Pierre de l'Inauguration du Temple.
8. Inscription—de Palenqué.
9. Mietlanteuhtli.

PALENQUE.

10. Bas-relief—Intérieur du Palais.
11, 12, 13, 14, 15. Grand Salles Sculptés } Temple des Inscriptions.
16, 17, 18, 19, 20. "
21, 22, 23, 24, 25. Bas-reliefs, Fond de l'Autel—Temple du Soleil.
26. Bas-reliefs, Fond }
27. } Temple de la Croix, No. 2.
28. de l'Autel }
29. Bas reliefs, Fond } Temple de la Croix, No. 1.
30. de l'Autel
31, 32. Bas-reliefs, sous-basement du Palais.
33, 34, }
35, 36, } Katunes—Inscriptions.
37. }
38, 39, 40. } Marches de l'Escalier.
41, 42. }
43, 44. De l'aile intérieure du Palais.

MERIDA.

45. Tête sculpté en angle. (Uxmal.)
46. Grand pilier—Colonne engagée.
47. Petit bas-relief de Cozumal.
48. Grand bas-relief de Cozumal.

CHICHENITZA.

49., 50. Grand bas-reliefs—Montants des portes, sud ouest du Castillo.
51., 52., 53. Pilier et chapiteau de colonne—Façade du Castillo.
54., 55., 56., 57. Piliers sculptés—Façade nord du Castillo.
58. Fragments de piliers et chapiteaux.
59. Intérieur de la Grande Salle du Castillo.
60, 61, 62, 63, 64, 65, 66, 67. Grand bas-relief composé de 8 pieces, intérieur d'une salle faisant partie du Jeu de Faune.
68, 69, 70, 71. Quatre piliers sculptés venant de la Salle supérieure du Jeu de Faune.
72. Linteau en bois sculpté, même salle.
73, 74, 75. Inscriptions sur linteaux de pierre, Palais des Nounes.
76, 77. Linteau sculpté et inscriptions venant du palais Akali—Sib.

LORILLARD CITY.

78. Bas-relief des Personnages avec Croix, venant du Temple.
79. Haut-relief, Linteau d'un palais.
80. Inscription du même linteau.
81., 82. Deux Inscriptions sur linteaux de pierre, d'un temple ruine. Linteau de pierre, d'un temple ruinée.
83. Copie d'une obsidienne portant la date de la construction du Grand Temple de Mexico.

The Philippine Islanders.—Dr. Samuel Kneeland contributes to the Bulletin No. 2 of the Am. Geog. Soc., a paper on the Philippine islands. Much space is given to the history of the islands and their geographical characteristics, but some very interesting facts are brought to light about the natives. The chewing of *buyo* is widely spread over the Indian and the Pacific ocean. The *buyo* is a bitter, pungent compound of a thin slice of the fresh *bonga,* the nut of the auca palm, enveloped in the green leaf of the betel pepper, a little lime being added to increase the stimulus. No race is more independent of industrial arts. His knife, or *bolo,* is the native's only essential implement; his spoon, bowl and basket he finds in the shell of the cocoanut; his basin, plate and

umbrella in the leaf of the banana; most of his domestic utensils in the bamboo; his house, his mat, his hat in the various kinds of palm; his fruit requires no cooking, and his fish and rice only the simplest. If ever there was a child of nature the Tajal is one. The insect and other natural enemies of man are plentiful. The Philippine islanders are skillful weavers of vegetable fiber and silk. It seems to be universally admitted that the Philippines were inhabited at an early period by a race of Negritos, whom the Malays drove into the interior. The other inhabitants are mixed Malays, Japanese, Chinese, Siamese, Dyaks and Javanese. The name *Igorroti* should be restricted to the hybrid Japanese and Chinese with the Indians.

SHELL ORNAMENTS AND PIPESTONE.— Mr. Stephen Bowers, writing to *Science* of June 22, criticises some of the positions assumed in Wheeler's Vol. VII, taking the ground that the curved shell fish-hooks were ornaments (see Plates XI and XII *op. cit.*). Mr. Bowers also sends the following interesting note on the occurrence of catlinite in California:

Pipestone.—In reading Mr. Barber's interesting article in the July number of the AMERICAN NATURALIST on catlinite, or pipestone, I was reminded of two beautiful specimens I found in an Indian burial place in Santa Barbara county, California, manufactured from this mineral. They are tubes, one of which measures a little more than five inches in length and five-eighths of an inch in diameter. The perforations are skillfully made, and the whole is finely finished. I have been unable to learn of any deposit of catlinite in California.—*Stephen Bowers.*

BERTILLON'S "SAVAGE RACES."—In the popularizing of science the French stand among the foremost. The most extensive series is the Bibliotheque des Sciences contemporanes. We have now to direct attention to another, Bibliotheque de la Nature, published under the direction of M. Gaston Tissandier. Two volumes of this series are by M. Alphonse Bertillon, whose death has been recently announced, to wit, Les Races de couleurs, curiosites ethnographiques, and Les Races Sauvages. The latter is a handsome octavo volume of 312 pages, with numerous engravings, and plates to illustrate the text. There is a table of contents on the last page, but no index to guide the traveler to his desired haven. The work is divided into four parts: the people of Africa, the people of America, the people of Oceanica, some peoples of Asia and the boreal regions. In his introduction M. Bertillon describes his method in the following words: Where it has been possible the abstract has given place to the concrete. Instead of saying this people are generous, that people are anthropophagous, the author has introduced anecdotes which lead to the same conclusions. In fine, M. Bertillon's volume corresponds to a series of popular lectures, such as are given in our principal cities during the winter season.

THE AMERICAN AUTOCHTHONES.— Professor J. Kollman, of Basel, well known for his many publications upon the crania of the European peoples, has made an elaborate study of the crania of our American aborigines. The author starts out with certain theses which he has sought to establish in other publications, such as the undoubted existence of races possessing invariable marks; man is a fixed type (Dauertypus), and races are also fixed since their production in the unknown past. Witness the Malays and Papuas, neighbors so long in a homogeneous tropical area, and yet so unlike. With regard to America it was formerly believed that a single race extended from Cape Horn to the Northern ocean, Blumenbach and Morton standing for this class of writers. Later on, from 1865, Waitz, Plotz, Andreas Retzius, Virchow and Daniel Wilson demolished the unity theory. Dr. Kollman divides his discussion into two parts:

1. The plurality of varieties (races) in America.
2. The spread of these varieties over the continent.

The data of his investigation are: North America, 917 skulls; Central and South America, 248 skulls; Eskimo region, 127 skulls; Mounds and shell-heaps, 208 skulls. The measurements are partly original and partly from Otis, B. Davis, and Schaaffhausen. Omitting the ancient crania, the index for the remaining 1292 is as follows:

	Index.	*Per cent.*
Dolicocephalic	63–75	22.77
Mesocephalic	76–80	35.92
Brachycephalic	81–85	22.60
Hyperbrachycephalic	86–95	14.30
Artificially brachycephalic	96–116	4.55

Every index from 86 to 116 is represented in Dr. Kollman's Table I. The same process is pursued separately upon the North Americans, Central and South Americans, Eskimos and Precolumbians. Even the Eskimos show over twelve per cent not dolichocephalic.

The chief results arrived at are the following:

1. The plurality of varieties is proved.
2. The ubiquity of these varieties over the whole area is undoubted.
3. The penetration of the varieties among one another is so complete that no tribe consists of a single variety.
4. This penetration had taken place before the Columbian period. From that era we have:
   a. Leptoprosope—Brachycephaly.
   b. Chamæroprosope—Brachycephaly.
   c. " —Mesocephaly.
   d. " —Dolicocephaly.
5. The differences of the Indian tribes are to be traced back not so much to climatic influences as the craniological evidences prove.
6. The differences among the ethnic groups are due to the amount of varietal penetration, which was not uniform in space or time.

It is Dr. Kollmann's opinion that human sub-species became fixed in the pre-glacial period, and that by the vicissitudes of time these have had greater or less influence upon varieties in different areas. The American continent, Eastern Asia and the Polynesian isles received only euthycomous varieties.

The accompanying table will exhibit Kollmann's scheme of the pre-glacial sub-species and varieties :

SUB-SPECIES.	PENETRATION.	VARIETIES, BY THE HAIR.
1. Chamæprosope—Dolicocephals (Long skulls, wide faces)	Europe, North Africa, West Asia	Cham. dolich. lissotrich. " mesoc. " " brach. " Leptopr. dolich. " " mesoc. "
2. Chamæprosope—Mesocephals (Medium heads, wide faces)		
3. Chamæprosope—Brachycephals (Short heads, wide faces)	America, East Asia, Polynesia	Cham. dolich. euthycoma. " mesoc. " " brach. " Leptopr. dolich. " " mesoc. " " brach. "
4. Leptoprosope—Dolichocephals (Long skulls, long faces)	Cent. Africa, So. Africa, Melanesia	Cham. dolich. ulotrich. " mesoc. " " brach. " Leptopr. dolich. " " mesoc. " " brach. "
5. Leptoprosope—Mesocephals (Medium heads, long faces)		
6. Leptoprosope—Brachycephals (Short heads, long faces)		

——:o:——

MICROSCOPY.[1]

THOMA'S SLIDING MICROTOME.—Dr. R. Thoma, extraordinary professor of pathological anatomy at the University of Heidelberg, has been good enough to write us the following description (in English) of his instrument, which has acquired considerable reputation both on the continent and in England.[2] He adds also remarks on it use :

The microtome (Fig. 1) consists of a stand of cast-iron, on which slide two carriers. The large knife is attached to one of these, *a*, which slides horizontally. The second, *b*, holds the specimen to be cut. This second moves on an inclined surface, so as to raise the specimen as required.

This, with a few modifications, is the general character of all

[1] Edited by Dr. C. O. WHITMAN, Newton Highlands, Mass.

[2] A description without figures appeared in Virchow's Archiv. LXXXIV (1881), pp. 189–91.

sliding microtomes; but hitherto the carriers were constructed to slide with two even surfaces between two even planes of the stand, which intersect at a given angle, with the consequence that all show more or less imperfect results, owing to the fact that it is impossible to obtain sufficiently exact plane surfaces. The inconveniences appear in small, scarcely perceptible irregularities of the movement of the carriers, and the consequent impossibility of making sections as thin as with an experienced hand.

This induced Professor Thoma to enter upon a consideration of the geometrical and mechanical difficulties to be surmounted. The question to be solved was, how many points at least of a body sliding between two planes must touch the latter for this body to be perfectly steady in its position. It will be found that five points are sufficient, and that a carrier on five points, between two plane surfaces, will slide without difficulty between these

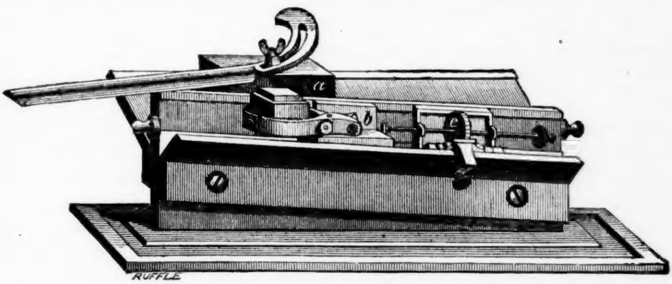

FIG. 1.—Thoma's microtome. *a*, carrier for the knife; *b*, carrier for the object; *c*, micrometer-screw for fine adjustment.

planes, even if they are not absolutely geometrical planes, or the angle which they include is not everywhere the same. Such a carrier will always take exactly the same course; and in consequence a knife attached to it will cut a series of perfectly parallel sections through an object which is successively raised to a higher plane after each cut. The working of the instrument will therefore be far superior to any microtome with large sliding surfaces which nowhere exactly fit the sliding surfaces of the stand. This indicates the desirability of constructing the carrier for the object on five points also.

The construction resulting from these principles is simple and practical, but it is necessary to take into consideration the centers of gravity of the different sliding bodies. This, however, complicates the matter. but very little. We replace the two sliding surfaces of each carrier by five slightly prominent points, and they will then move with exactness on any combination of two planes, not differing too much from geometrically plane surfaces. One condition only must be fulfilled, namely, that the five points are so chosen as to support steadily the center of gravity of the

carriers, including their accessory parts, namely, the knife and object. Fig. 2 gives a more precise idea of the details of construction.

In the figure the lower surfaces of the carrier *a*, which supports the knife, show three prominences, which gives the geometrical projection of the five points. Within the limits of the figure these points could not be drawn exactly as they are in the instrument itself. In reality they appear only as small prominences upon three narrow ridges on the sliding surfaces of the stand. This arrangement was desirable to facilitate the action of the oil with which the sliding surfaces are to be covered. Two of the ridges form together parts of the oblique plane, and the third corresponds to the vertical sliding plane. The same arrangement is found in the carrier *b*, which supports the clamp in which the object is placed.

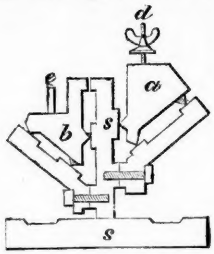

FIG. 2.—Transverse section of the microtome. *s s*, stand; *a*, carrier for the knife; *b*, carrier for the object; *d*, screw to attach the knife; *e*, axis supporting the clamp for the object.

By this mode of construction the carriers will move gently and regularly, even if the sliding surfaces on the stand are not perfect geometrical planes. It is still, however, of course desirable that as much exactness as possible should be obtained in these planes, as their irregularities cannot fail to affect the sections, especially as they are in fact multiplied in the latter. Professor Thoma highly commends Herr Jung, of Heidelberg, who makes the microtomes under his instructions, for the great exactness which he has obtained.[1]

As the efficiency of the newly-constructed instrument is best judged of by practical experience of its capabilities, Professor Thoma (besides stating generally that it has been found that any one can produce sections of great delicacy with this microtome without previous practice) gives the following facts: Specimens which are well hardened will allow of sections of three to four square centimeters surface and 0.015 to 0.10^{mm} thickness. In exceptional cases pieces of so large a surface may be cut of 0.005^{mm} thickness. If the section is smaller (for instance, one centimeter square), the thickness can be reduced considerably,

[1] Professor Thoma remarks that at a time when already a number of his microtomes were in use, an instrument entirely different in its general appearance, but yet constructed on similar principles, appeared in America—the microtome of Mr. Fletcher (Boston *Medical and Surgical Journal*, 1880). The knife-carrier slides on five points on the bottom of a large basin filled with alcohol. This microtome shows such eminently different qualities to the one explained here, that the independence of the invention is on both sides very evident. The value of the principle, however, is at the same time demonstrated by the relative good results which have been obtained by this American machine. Its limit as regards the thinness of the sections appears to be 0.0004 in.

say to $0.005^{mm.}$ or in extreme cases to half that. It is not, however, all tissues and objects that will admit of sections of such delicacy. Well-hardened liver may generally be cut to $0.015^{mm.}$ this being about the diameter of the hardened cell. Occasionally, however, in this tissue, sections of 0.010^{mm} can be obtained. Lymphatic glands and brain may be cut to 0.010 or 0.075^{mm}; embryonic tissues, well imbedded, usually admit sections of 0.005 and $0.003^{mm.}$ In some cases even sections of 0.002^{mm} thickness can be obtained. These numbers refer to the largest size of the microtome, and to serial sections. The two smaller sizes will give sections of the same delicacy, but comparatively smaller in extent of surface. The length of the sliding surfaces of the large instrument is $40^{cm,}$ and the edge of the knife is $23^{cm.}$ In the medium size these dimensions are 27 and $16^{cm,}$ and in the smallest about 21 and $11^{cm.}$

Professor Thoma also adds some practical remarks on the use of the microtome and the necessary previous preparation of the specimens, it being his opinion that further progress in section-cutting is to be expected from the perfecting and development of the technical methods of preparing, hardening, soaking and imbedding the tissues. Personally he feels sure that any tissue (excluding bone and teeth before decalcification) may be prepared so as to be cut to any degree of delicacy down to $0.002^{mm.}$ The microtome will work with sufficient exactness to permit this, but hitherto there are only a few tissues which we can prepare so perfectly as to admit sections of such extreme minuteness. The following are the points to which he most especially wishes to draw attention:

Sliding microtomes are in general constructed for cutting sections of tissues previously hardened in alcohol, picric acid, chromic salts and other agents. Fresh tissues are decidedly better cut by freezing microtomes, for instance, on the simple and practical instrument of Hughes and Lewis. The addition of a freezing apparatus to a thoroughly exact sliding microtome is neither advisable nor necessary. The differences of temperature produced in different parts of the instrument would be apt to interfere with the perfect planeness of the sliding surfaces; whilst, on the other hand, section-cutting with frozen tissues is so simple and easy with the ordinary freezing apparatus that any further complication in the way of a sliding support of the knife is superfluous.

In cutting the microtome is to be placed before the operator as in Fig. 1, with the sliding surfaces abundantly covered with oil (bone oil), and the knife moistened with alcohol. In many cases it will be sufficient to simply place the hardened specimen between the arms of the clamp attached to the carrier *b* (Fig. 1). The clamp should then be fixed in such a position that the specimen is as near as possible to the knife-carrier. The knife will

generally have to be adjusted so as to bring the whole length of its blade into action. Very hard specimens are frequently cut with less difficulty by placing the knife more obliquely in regard to the long diameter of the instrument.

The inclination of the oblique plane upon which the carrier *b* slides is 1 : 20, and consequently the section will be 1-20th^{mm} thick if the carrier is moved 1^{mm} on the oblique plane. A scale in millimeters with a vernier allows the operations to be exactly regulated. The vernier will be found sufficient for sections of 0.015$^{mm.}$ Sections of greater delicacy should always be made by using the micrometer-screw (*c*, Fig. 1), which was designed to obtain the utmost exactitude in the management of the carrier *b*. Fig. 3 shows it on a larger scale.

The carrier *c'* slides on the same oblique plane as the carrier *b*

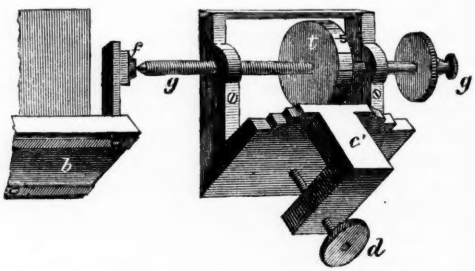

FIG. 3.—Micrometer-screw for delicate sections.

which holds the specimen. In all positions of the latter it is therefore possible to bring the point of the micrometer-screw, *g g*, close to a small polished plate of agate, *f*, which is fixed to the carrier *b*. In this position *c* should be firmly screwed to the stand of the microtome by *d*, and every revolution of the micrometer-screw, *g g*, will then push the carrier *b* 0.3$^{mm.}$ The periphery of the drum, *t*, which is firmly attached to the screw, *g g*, is divided into fifteen equal parts; and consequently each division marks a thickness of section equivalent to 0.001$^{mm.}$ The finest sections hitherto produced reach only 0.002^{mm} thickness.

Since the first microtome was taken into use a series of minor improvements have been made. One of them consists in a clamp (Fig. 4) for holding the object, which can be turned round three axes, and admits, therefore, of a very easy adjustment of the object in regard to the knife. It was devised to meet the desire for occasionally turning the object between two successive series of sections.

The two metal plates, *h h*, form the jaws of the clamp. Between them is placed the cork which carries the specimen, and the latter is fixed by turning the screws, *g g*. The three axes are *a*, *b b*

and *c c*, and round these the clamp can be turned, *a* being vertical, and *b b* and *c c* horizontal. In all positions these three axes can be made immovable by the screws *d e f*. The axis, *a*, is formed by the vertical rod, *e* (Fig. 2) on the carrier supporting the clamp and object. The details of the construction are partly new, and are very solid and durable. Their arrangement is such as to admit of a division of the circles in which the clamp can be turned.

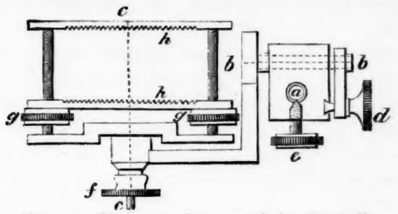

FIG. 4.—Clamp to be turned in three directions (as seen from above).

Another improvement has been devised by Mr. Jung. This is an arrangement which regulates the movement of the micrometer-screw in such a way that after a given number of divisions of the drum, a spring registers to the ear and finger of the manipulator the number of micromillimeters which the object has been raised. These intervals can be varied, within certain limits, by a simple adjustment comparable to a vernier. The construction of this apparatus is decidedly very elegant, but the divisions of the drum of the micrometer-screw are so large and easily visible, even to weak eyes, as in Professor Thoma's opinion to make such complications useful only for very special conditions.

Other improvements by different manipulators relate merely to secondary points, and do not touch the essential principles of construction.

Taking the hardened specimen directly between the arms of the clamp is generally not advisable, as by such a proceeding sections of great delicacy cannot be obtained. It should be fastened with gum arabic to the even surface of a square piece of cork, and the latter inserted in the clamp. In this way compression is avoided. A concentrated solution of the gum is placed on the surface of the cork, and the hardened specimen is watered a few moments to drive away the alcohol from the surface, and it can then be adjusted on the gummed cork and plunged again into alcohol. The latter will, in a few hours, harden the specimen as well as the gum, and we obtain a preparation like Fig. 5.

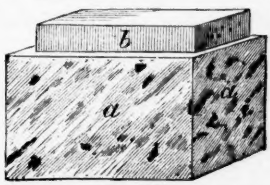

FIG. 5.—Hardened specimen *b* adapted to cork *a*.

These methods are sufficient for the great majority of cases, and the different animal and vegetable tissues can be cut into sections varying according to their structure, between 0.030 and 0.005$^{\mathrm{mm.}}$ Sometimes, however, and always if sections of extreme delicacy are required, it

is necessary to use more complicated procedure. For example, the normal human lung hardened in alcohol and prepared as above, will perhaps admit of sections of 0.030^{mm}: a human lung affected by acute pneumonia may perhaps be cut to 0.015^{mm}, but if greater delicacy is required, the tissue must be soaked in gum arabic, or other substance which admits of a more solid hardening. In this case human lung will allow of sections down to 0.001^{mm}. Objects of very small dimensions, like embryos, small animals, leaves of plants, &c., must be imbedded in suitable masses, which may be adapted to a cork, as above, before they are cut.—[*To be continued.*]

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SCIENTIFIC NEWS.

— In closing his second lecture on whales Professor Flower argues against the theory of the derivation of the whales from the Carnivora, and the idea that whales are an extreme modification of the seals and sea-lion, calling attention to the fact that the hind-limbs are aborted and the tail developed into a powerful swimming organ. He thinks it more reasonable to suppose that whales were derived from animals with large tails, which were used in swimming, eventually with such effect that the hind limbs became no longer necessary, and so gradually disappeared. "The powerful tail, with lateral cutaneous flanges, of an American species of otter (*Pteronura sandbachii*), or the still more familiar tail of the beaver, may give some idea of this member in the primitive Cetacea." He therefore suggests the derivation of whales from the lower Ungulates, and that the earliest forms were fresh-water types; the fresh-water origin of the group accounting for their otherwise inexplicable absence from the Cretaceous seas.

— The Chinese and Japanese exhibits at the International Fisheries exhibition must be novel and striking. An article in *Nature* calls attention to the extraordinary ingenuity displayed in utilizing the most ordinary and unpromising objects for the purpose of fishing. Thus in Swatow they employ a boat drawing a few inches of water, with the rail nearly level with the surface. A narrow plank fixed along one side is painted white, and the light of the moon falling on it causes the fish to mistake it for water. They jump over the plank into the boat, when they get entangled in moss or grass. At Ichang, a wild animal, such as the otter, is trained, not to catch fish, but to frighten them into the net; while at Ningpo cormorants are regularly and systematically trained to fish. These and many other devices shown at the exhibition mark the Chinese as the most ingenious and accomplished fishermen in the world.

— In his notice of MM. Carl Vogt and Emil Yung's treatise

on practical Comparative Anatomy, Quatrefages stated before the French Academy that for Darwin's biological tree, representing all life past, present and even future on the globe, Vogt and Yung substitute a grove composed of many distinct trees, the number and species of which still remain to be determined. "But," he adds, "while this conception deprives the Darwinian theory of much of its seductive grandeur, evolution itself can lose nothing by abandoning an absolute system in which mere hypothesis plays far too large a part."

— Still a new zoölogical journal has been started in Germany. The first number of the *Zoologische Beiträge*, edited by Professor Anton Schneider, of Breslau, contains articles on the development of *Sphærularia bombi*, by A. Schneider; on the anatomy of Nematodes, by E. Rohde; on the anatomy and histology of Peripatus, by E. Gaffron; on the reproductive process in bony fishes, by A. Schneider; and on the development of the sexual organs of insects, by A. Schneider.

— As we are about going to press the American Association begins (Aug. 15) its annual session in Minneapolis, one of the most beautiful cities of the West. President Dawson was to deliver the retiring address, while the meeting will be presided over by Professor C. A. Young. In the same week and place (Aug. 13–14), the Society for the Promotion of Agricultural Science was to meet, and (Aug. 14) the Cambridge Entomological Club was to hold a public meeting.

— Several apparently new destructive insect pests, besides the Phylloxera have made their appearance in California; one is the peach moth (*Anarsia lineatella*). It was first noticed in 1882, but during the past summer has spread to an alarming extent. Mr. M. Cooke also reports that the branches of the olive are bored by a beetle, *Polycaon confertus;* it also infests the branches of the pear, cherry, apricot, plum, apple trees and grape canes.

— The library, laboratory and museum of Indiana University at Bloomington, was recently burned, involving the loss of the Owen collection of fossils, and Professor Jordan's extensive collection of fishes. Professor Jordan's work on the fishes of the United States, has recently been published by the Smithsonian Institution, and the collection formed a part of his types.

— We have received a catalogue of books and papers relating to the fertilization of flowers, compiled by D'Arcy W. Thompson, and extracted from the English edition of Dr. Hermann Müller's Fertilization of Flowers. The number of entries is 814, and those of American authors appear to have been carefully recorded.

— The sixth annual meeting of the American Society of Mi-

croscopists was to be held in Chicago, beginning Aug. 7 and continuing four days.

— We have, for lack of space, failed to notice several recent geological papers of interest. These are Mr. G. K. Gilbert's Contributions to the History of Lake Bonneville, extracted from the annual report of the Director of the U. S. Geological Survey, 1880–81. It is finely illustrated and gives the results of several seasons' explorations. Professor W. M. Davis publishes in the Bulletin of the Museum of Comparative Zoölogy, Vol. VII, a well illustrated paper on the relations of the Triassic traps and sandstones of the Eastern United States; also a second paper on the folded Helderberg limestones east of the Catskills, with numerous diagrams.

— A monument to the memory of the celebrated naturalist and physio-philosopher, Oken, has been erected at Offenburg. Visitors to the University grounds at Jena will remember seeing his bust there, which has been on exhibition for many years.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Philadelphia Academy of Natural Sciences, April 5.—Mr. Cresson exhibited some Aztec flageolets and whistles, and proved that by closing the bell of the flageolets with the little finger the entire octave could be produced. Each whistle was correctly pitched, and a series gave a complete octave, together with the ninth, eleventh, and twelfth. Mr. Cresson argued from these facts that the Aztecs were acquainted with the full musical scale, instead of being limited to the pentatonic scale, as has usually been believed to be the case with them and other barbarous nations. In the comparison of these instruments with the Boehm flute he was assisted by Professor J. S. Cox. Mr. Cresson also stated that he had examined the construction of these flageolets, and had endeavored to imitate it. He had reason to believe that the instrument was formed of four parts, the mouth-piece, the reed, the body, and the bell. Professor Lewis objected that though the entire scale can be produced by a skillful modern performer from a four-holed instrument, this did not prove that those who made the instrument possessed the skill and knowledge to produce it. Mr. Skinner showed some cocoons of the Cecropia moth gathered from the elder. Those taken from near the base of the shrub were of stouter form than those gathered from higher up, and always proved to be females, while the slimmer cocoons found on the higher branches always turned to male.

April 12.—Professor E. D. Cope gave particulars of recent palæontological discoveries in Brazil. Brazil consisted of two

islands until, at the end of the Cretaceous, the Andean range cut off the sea to the west. Since then a great Tertiary formation was laid down and the Amazon basin defined. The deposit made by the river and its branches is not older than the post-pliocene. Cretaceous strata occur near Pernambuco, and in these have been found the remains of several genera of sharks, and of a crocodile of the genus Hyposaurus, which occurs also in New Jersey; also a genus of rays (Mesedaphus). These remains indicate a horizon corresponding to the Maestricht chalk. A new pycnodont, *Pycnodus flabellatus*, had been found at Mapiri. In the lacustrine beds near Bahia many fish and saurians have been found, and crocodiles and dinosaurs, the former indicating a horizon above the Pernambuco beds also occur. He thought the age would prove to be near the Laramie. Some pampean beds near Bahia as yet have yielded only one fossil, *Toxodon expansidens*, sp. nov. A batrachian (Aræarthrosus Cope, gen. nov.) has been found in San Paolo, and is probably Permian, but may be Carboniferous. The pliocene vertebrates of Brazil are very distinct from those of North America, but the fossils now being studied indicate marked similarity in earlier periods.

April 18.—Professor Heilprin spoke of some invertebrate fossils from Santa Cruz, Patagonia. Tertiary deposits are traceable along nearly all the rivers of this region, and superimposed on those are the pampean shingle beds. The fossils greatly resemble those of N. Europe and Asia. Some forms are like those of our west coast. Dr. H. C. McCook spoke of the mode followed by orb-weaving spiders in making their snares. The foundation lines form an irregular polygon. After securing these the spider places the radiating lines alternately and almost opposite to each other, retiring to the center after making each attachment. This alternate opposition of the lines serves to strengthen the web. He believed the radii to be single lines. The converging point of the radii frequently seemed above the geometric center, probably to resist the spider's weight.

April 26.—Professor E. D. Cope described the head of *Diclonius mirabilis* Leidy, a saurian allied to the Hadrosaurus of the New Jersey marl. A nearly perfect skeleton from the Laramie beds of Dakota was in the speaker's possession. The head was bird-like in appearance, with spoon-like premaxillaries. Mr. Wortman expressed his belief that *Galera macrodon* from the Post-pliocene of Maryland should be placed in the genus Putorius, and dwelt on the relationships of the Mustelidæ; he did not attach much importance to color, size, and other individual variations. Dr. Horn exhibited a piece of bed-ticking from a bed the feathers in which had been destroyed by *Attagenus megatoma*. The interior surface of this ticking was converted into a fine plush by the penetration into the interstices of the material of the fine barbules of

the feathers. A discussion ensued as to the actual nature of the plush. Dr. Leidy described *Raphidiophrys socialis*, a heliozoön found in New Jersey. This animal occurred in groups of sometimes upwards of a hundred. They remained nearly stationary for as long as twenty-four hours, and fed upon two species of minute monads, which they swallowed like ordinary sun-animalcules.

May 3.—Dr. Leidy stated that examination of the plush exhibited at the last meeting had proved that it was really formed of feathers. Miss G. Lewis stated that she some years ago examined a similar material, known to have been formed from filaments of gull feathers, and that a cloak had been made of it that wore well. Professor Cope spoke of the characters of the molars of the Bunotherian mammals, and objected to Mivart's interpretation of their homologies. By comparison of recent and fossil forms, he concluded that the V's of the molars of the Insectivora had been formed in both jaws by the connection of cusps, and not by a flattening of tubercles, as may have been the case in animals having lateral motion of the jaws (as the Ungulates). He defined about seven series of forms based on the mutations of the tubercles. Professor Lewis read a paper by Miss Foulke upon a rotifer presumed to be new.

May 10.—Mr. J. Wilcox gave some interesting particulars respecting the surface soils of Canada, which are thin and poor, while water is scarce. He believed that the Laurentian rocks were once covered by sedimentary strata, since removed by erosion. The same speaker gave an account of the altered habits of the sheepshead and some other fishes in Florida. They enter fresh-water streams and feed on Conferva and other vegetable food. Professor Lewis read for Miss Foulke a description of a new species of rotifer, named by her *Floscularia articulata.*

May 17.—Dr. Clevenger, of Chicago, gave the result of his researches upon the valves in the vascular system. In a quadruped the horizontal veins of the trunk had no valves, while the vertical ones, those of the limbs and intercostal spaces, are furnished with them. In man precisely the same arrangement prevails, although the horizontal veins have become vertical and the vertical ones horizontal. He also alluded to the tendency to hernia produced by the want of strength in ligaments which in man had to bear the weight of the viscera; to the exposure of the femoral artery caused by man's erect position, and to the widening of the upper and narrowing of the lower rim of the pelvis from the constant strain brought to bear upon it, as another consequence of the erect position.